ONTARIO SOIL, WATER AND AIR RESEARCH SERVICES COMMITTEE

1999 ANNUAL REPORT TO

ONTARIO AGRICULTURAL SERVICE COORDINATING COMMITTEE

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1999 OSWARSC REPORT

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Table of Contents

Executive Summary v

Introduction 1

OSWARSC Terms of Reference 3

Industry / Sector Scan
1. Major Accomplishments in 1999 4
2. Current State of the Industry 4
3. Emerging Issues 6

Research Issues And Recommendations - 1999 8
New Recommendations 9
Existing Recommendations 11
A. Infrastructure Issues 11
B. Research Issues
1. Manure Management Issue 19
2. Nutrient Use Efficiency Issue 24
3. Water Management Issue 29
4. Soil And Crop Management Issue 32
5. Best Management Practices Issue 40
6. Biosolid / Waste Application And Treatment Issue 44
7. Greenhouse Gas Issue 47

Service Recommendations - 1999 54

APPENDICES

Appendix I Sub-Committee Reports I-1
1. Ontario Agrometeorology Research and Services Committee I-2
2. Ontario Soil Management Research and Services Committee I-11
3. Ontario Water Management Research and Services Committee I-32

Appendix II Committee Memberships II-1

Appendix III Committee Terms of Reference and Mandates III-1

Appendix IV Current Inventory of Research Projects in Ontario IV-1

Appendix V Issue Champion & Supplementary Reports (7 reports) V-1

Infrastructure Issue - Soil Resource Management - Larry Schut, OMAFRA V-2

4. Manure Management - M. Goss, Univ. of Guelph V-5
5. Nutrient Use Efficiency - I. O'Halloran, Ridgetown, Univ. of Guelph V-9
6. Water Management
   A. Wetland/Waster Water - C. Weil, Alfred, Univ. of Guelph V-15
   B. General - Tiffany Svensson, Ontario Federation of Agriculture V-25
4. Soil and Crop Management - C. Drury, GPCRC, AAFC, Harrow V-27
5. BMPs - D. Aspinall, OMAFRA V-31
6. Biosolid / Waste Application and Treatment - Larry Schut, OMAFRA V-35
7. Agriculture and Agri-food Table on Climate Change - Maria Alles deVos V-36

Appendix VI Report of Action Taken on 1998 Recommendations VI-1

Appendix VII Summary of Distribution of 1999 Recommendations VII-1

Appendix VIII Coding System for Recommendation Priorities VIII-1

Appendix IX Glossary of Acronyms IX-1

Appendix X 2000 Provisional Meeting Dates X-1

EXECUTIVE SUMMARY

The 1999 OSWARSC Report continues to undergo changes in organization and in content, as a part of the OASCC re-structuring process. This is second year of the four-year reporting cycle for the OSWARSC Committee, and thus fewer new recommendations are introduced than in the Strategic Fourth-Year Report. To make the system more responsive to research recommendations, we have initiated an inventory of more than 135 current research projects (Appendix IV), organized by the seven Priority Issues. This should become a useful tool in tracking how research activities respond to the previous years' recommendations.

Research recommendations for 1999 are again grouped according to the following Priority Issues, listed in order:

1. ***Manure Management***
2. ***Nutrient Use Efficiency***
3. ***Water Management***
4. ***Soil and Crop Management***
5. ***Identification / Validation of Best Management Practices***
6. ***Biosolid / Waste Application and Treatment***
7. ***Greenhouse Gas Emissions***

There has been some positive activities at both levels of government in 1999 towards addressing the infrastructure issues outlined in the 1998 report, especially with the preservation and enhancement of the land resource data bases. This comes at a critical time when accurate information is required for precision farming practices, as well as for siting intensive livestock operations. Concerns continue to be raised about Ontario's groundwater aquifers, both in terms of quality and quantity. Intensive efforts need to be initiated to accurately map these aquifers. In order to properly support Integrated Pest Management Practices in Ontario, gaps in the weather collection network in Ontario need to be remedied, and there needs to be more uniformity in weather data collection.

Manure management continues to be the top Research Priority for the Committee. The two decision support systems, NMAN99 and McCLONE4 are being integrated into a comprehensive package, which should be of considerable assistance in implementing Nutrient Management Plans for larger livestock operations.

There has been only modest progress during the past year on some of the technical issues involving application protocols for biosolid application on agricultural lands.

There has been little activity during the past year towards solving the problems of scaling (temporal and spatial) as they apply to the development of Best Management Practices. The success or failure of many BMPs strongly depends upon the selection of an appropriate observation/measurement scale.

INTRODUCTION

In the 1998 report we raised concerns about the increasing competition for natural resources available for food production, while concurrently, there seemed to be mounting evidence that rapid climatic changes were starting to have direct impacts on Ontario agriculture. In 1999, the average temperature was again one of the warmest on record, and when combined with a widely varying rainfall, it resulted in highly variable crop yields across the province, despite the fact that 1999 rainfall average was near the 30-year normal. Areas receiving adequate and timely rainfall produced near-record corn and soybean yields.

As Ontario agriculture increasingly relies upon supplementary groundwater supplies for irrigating crops, it is on a collision course with both the urban sector and with non-agricultural industries (e.g. spring water bottlers) as everyone competes for the same groundwater sources. Of great concern is the fact that we don't have accurate maps of our groundwater aquifers, nor their pumping capacities.

During the past year there has been an increasing level of activity, especially at the Federal level, towards addressing national obligations to the Kyoto protocol. Agriculture is starting to respond to these challenges as well. In order to reduce greenhouse gas emissions towards the 1990 level, there will have to be significant changes in how our economy operates, and in turn this could have very significant impacts on energy costs, and how agriculture manages its livestock and crop production systems.

The Ontario Soil, Water and Air Research and Services Committee (OSWARSC) serves Ontario Agriculture by prioritizing research and service needs in the broad areas of:

- the agricultural and rural environment,
- soil and water management recommendations for agricultural producers,
- recommendations for agricultural producers that deal with weather and atmospheric conditions.

OSWARC continues to organize the research recommendations around the seven Priority Issues. For the first time, we have developed an inventory of more than 135 current research projects in Ontario (Appendix IV), and grouped them according to the seven priority issues for the purpose of gauging the response to the previous year's recommendations. Lack of projects under any particular Research Recommendation may be an indicator that further attention is required to that recommendation.

Memberships and mandates for all of the sub-committees and main committees continue to be reviewed, in light of the changing nature of how agriculture is being practiced and regulated in Ontario. For the first time the Committee had representation from OMAFRA's Policy Analysis Branch. In 1999, the Agricultural Weather Services Committee was folded into the parent Agrometeorology Research and Services Committee.

As a result of the Agricultural Weather Services Committee being folded into its parent Agrometerology Research and Services Committee, there are now three major sub-committees, and six sub-committees, as follows:

Ontario Soil, Water and Air Research and Services Committee
- ***Ontario Agrometerology Research and Services Committee***
- ***Ontario Soil Management Research and Services Committee***
  - ***Field Crops***
  - ***Horticultural Crops***
  - ***Soil and Water Quality***
  - ***Soil Test Lab***
  - ***Tobacco***
  - ***Waste Utilization***
- ***Ontario Water Management Research and Services Committee***

Table 1. 1999 Sub-Committee Meetings

Committee	Chair	1999 Annual Meeting	
		Date	Location
OSWARSC	Chair: Dr. Bruce Bowman, SCPFRC London, AAFC Vice-Chair: Keith Reid, OMAFRA, Walkerton	Nov. 23 - 24	OMAFRA, Guelph
OARSC	Dr. Alan McKeown, Univ. of Guelph	Nov. 9	Univ. of Guelph
OSMRSC	Dr. Ivan O'Halloran, Ridgetown College, Univ. of Guelph	June 15 -16	Univ. of Guelph
OWMRSC	Co-Chairs: Dr. ChinTan - GPCRC, AAFC, Harrow Dr. Ramesh Rudra - Univ. of Guelph	Sept. 28	University of Guelph

OSWARSC TERMS OF REFERENCE

The Ontario Soil, Water and Air Research and Services Committee (OSWARSC), formed in 1971, has three subcommittees, namely, the Ontario Agrometeorology Research and Services Committee, the Ontario Soil Management Research and Services Committee, and the Ontario Water Management Research and Services Committee.

Duties and Terms of Reference

1. To identify soil, water and air research required in relation to present and future needs and opportunities for development of the agricultural industry in Ontario.

2. To access and make recommendations on the priorities to be applied to these matters.

3. To facilitate means of meeting such needs efficiently with the resource available from time to time by:

   a) considering and approving chairmen and membership of subcommittees;

   b) evaluating cost-benefits of research;

   c) examining the suitability of institutions or persons to assume responsibility for various research programs;

   d) projecting resources needed for research;

   e) describing how resources may be obtained or freed for new program requirements'

   (f) reviewing operations of subcommittees through reports submitted;

   (g) reporting to OASCC on such matters as required; and

   (h) promoting greater interaction between scientists in soil management, water management, agrometeorology, and soil survey and land use, and between scientists and extension personnel.

INDUSTRY / SECTOR SCAN

1. Major accomplishments in Past Year

In the 1998 report we raised the serious issue of the land resource data bases, which appeared to be in great jeopardy because of the retrenchment resulting from both Provincial and Federal cutbacks. It has been quite gratifying to see some very positive activities initiated to correct those problems and to further enhance the extent and quality of those data bases. However, current partnerships need to be broadened to include other key groups that have skills and resources to contribute.

At the provincial level, the "cluster ministry" concept has been developed in which select working groups across several ministries have been drawn together for specific activities, such as upgrading the land resource data bases.

The Ontario Rural Wastewater Centre has been created by the University of Guelph (Collège d'Alfred and the School of Engineering) in partnership with the Rideau Valley Conservation Authority and many industry and government stakeholders. The Centre has demonstration sites in Central Ontario at the University of Guelph and in Eastern Ontario at the Collège d'Alfred with a satellite site at the Baxter Conservation Area to the south of Ottawa.

The two decision support systems, NMAN99 and McCLONE4 will be integrated into a comprehensive package by Spring 2000, which should be of considerable assistance in implementing Nutrient Management Plans for larger livestock operations.

2. Current State of the Industry

A key driving force this past year was reduced grain prices. In most areas, this has been balanced by greater yields of corn, soybeans, canola and cereals, although there are some pockets where dry weather reduced yields as well. The reduced prices in the hog market have recovered to a large extent, but not to the point of being highly profitable. The cattle market has been quite buoyant. The supply managed industries (dairy, poultry) have been stable, with a trend towards larger operations.

The expansion of livestock operations, particularly hog barns, has been a hot issue among rural residents. Exacerbating the tension have been problems in local areas with poor barn construction, resulting in manure leaks to tiles, and improper manure application. Huron County continues to have some problems with large hog farms, a few of which have had some manure spills, and which made local press headlines. Ontario Pork has conducted a survey to sample public opinion as to their views of the industry, so that they can take some pro-active steps to remedy the identified problems.
During 1999, the Nutrient Management Planning process was featured at a very successful Niagara Falls Workshop in late March. NMPs are receiving increasing recognition as an

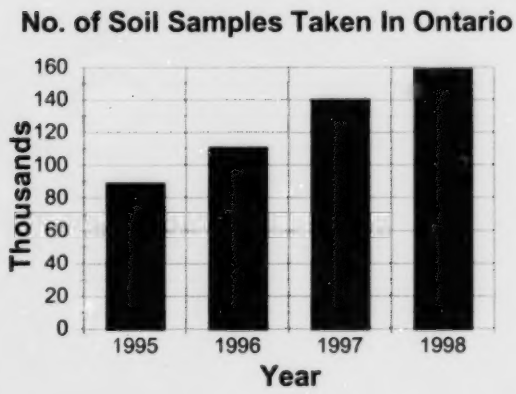
effective means of optimizing nutrient usage for crop production while protecting the environment. Although they are currently being required for new large livestock operations, we can forsee in the not-to-distant future that all crop producers will be using NMPs for managing their nutrient use, not just because of the environment, but also because they will increase efficiency and profitability for the producers.

Many localized areas in Ontario suffered through another droughty year, which had severe negative impacts on crop yields in the areas affected. While on average a normal amount of rain fell on Ontario in 1999, the spatial and temporal distribution was highly variable, and in some cases large rainfalls did occur in which there was considerable runoff and less than effective use of the precipitation by crops.

As we noted in last year's report, competition for water (within agriculture, and among agriculture-industry-urban) is becoming an increasingly important issue. This past summer, irrigation had to be curtailed in the Simcoe area, along the north shore of Lake Erie, because of limited water supplies. At the same time, there were water shortages reported by farmers in Grey County, while water export licences were being granted for bottling firms wishing to export spring water.

Biotech and GMO (genetically-modified organism) issues started receiving increased attention in late summer, as environmental groups started a concerted campaign to raise public concerns. There seems to be an increasing desire by various public groups to have the Federal Government label all food products produced using GMOs.

The number of soil samples taken in the province has almost doubled since 1995 (88,861- '95; 110,644 - '96; 140,000 - '97; 158810 - '98), of which those for field crops were 76% of the total (120,618), vegetables - 8% (12,937) potatoes - 5% (8,084); fruit - 3% (5,135); tobacco - 8% (12,036). There is no indication that the total acreage under crop production has changed significantly over this period.
The number of manure sample remained constant at 1,100. The amount of fertilizer sold in the province since 1995 is shown in the following table:



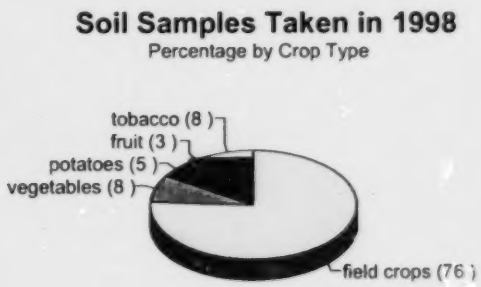


Table 2. Fertilizer Sold and Nutrient Content (Ontario)*					
Year ending June 30	Total Fertilizer Sold	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	All Nutrients (N+P+K)
1999	744,470	168,684	67,200	126,489	362,073
1998	782,639	171,971	75,154	134,894	382,019
1997	691,232	152,211	70,560	116,571	339,342
1996	728,344	172,311	61,135	128,033	361,479
1995	762,694	174,630	79,860	126,823	381,313
* - data courtesy of T.F.I.O.					

3. Emerging Issues

Since we introduced greenhouse gas emissions as a new OSWARSC Issue in 1998, the broader issue of Climate Change has received increasing attention in the public press, as well as in scientific circles. While agriculture is perhaps the most sensitive sector to climate change, it may well also be more amenable to "intervention". While greenhouse gas emissions have direct ties to the climate change issue, there are other factors involved as well. An emerging concern is the ability of our agricultural production systems to adapt to rapid climate changes, and to the Kyoto Agreement on greenhouse gas emissions. As a result of rapid climate change, crop insurance claims could increase dramatically and food security could be at risk.

Increasing air pollution and UVB burn may present an increasing threat to plants as well as to humans. Industry has identified a need for diagnostics and references for both. These need to be identified and symptoms, including air pollutants injury provided to growers. For example, Industry representatives reported a scab on apple fruit this year that was non pathogenic. Sprays were made to control scab that was not cased by the scab pathogen. Others have noticed unusual burns on plants in 1999.

The water sharing issue which was raised in 1998 continues to become increasingly contentious. Rural Ontarions are quite sensitive to export licences being granted to spring water bottling firms at the same time that there is a tight supply of water for irrigating agricultural crops in the same region. It appears that we do not have an adequate inventory of our groundwater resources (aquifer size and pumping capacities). It's going to be very difficult for agriculture to convince industry and urban sectors to be very careful with their use patterns for our shared groundwater if, in fact, we don't even know what the extent of the aquifers are, and how much water we can

safely remove from them, or their recharge rates. It's not even clear whether we currently have the technology/methodologies to properly characterize these aquifers. It could be a rather expensive proposition to fully characterize our groundwater resources. At the present time, there does not seem to be a clear policy for water access rights, after priority access for human and animal requirements.

For some time there have been considerable inconsistencies in the quality and coverage of weather data collected at various locations across the province, and furthermore, there are areas from which little or no weather information is currently collected. It is critical that the quality of climatic data being collected be improved so that Integrated Pest Management programs in the province can be maintained and enhanced. This issue of weather data may well become even more important with increased use of Precision Farming practices, so that yield data can be more closely correlated with local temperature and moisture information.

RESEARCH ISSUES AND RECOMMENDATIONS - 1999

In 1999, OSWARSC continues to organize this Report around the **seven Priority Research Issues** confronting Ontario Agriculture, as identified by the Committee. It decided that the priority order for the seven issues remains the same for this report.

Careful attention is devoted to balancing the needs of production agriculture with environmental protection concerns (soil, water, air), towards development of "sustainable" agricultural production systems. Multiple recommendations within an Issue are presented in order of priority. Since the mandate of this committee is resource-based, rather than commodity-based, the recommendations cut across interests of the other committees. Accordingly, we identify, with each recommendation, other OASCC committees that would share in the ownership of those particular recommendations.

In 1998, OSWARSC identified a number of serious deficiencies in the research infrastructure that needed to be addressed. Unlike service recommendations which address tech transfer issues / delivery of information to clients, etc. (now sent directly to the target agencies), infrastructure recommendations target the research support structures themselves. The basic infrastructure must be in place and functional for effective follow through on the Research Recommendations, as well as for the effective extension of research results. In addition, new concerns, such as greenhouse emissions and the issue of scaling need to be integrated into the infrastructure.

Since this is a "minor-report year" for OSWARSC, the 'new' recommendations are placed separately at the beginning of this section. The numbering of these new recommendations follows in sequence with that of existing recommendations within each Priority Issue.

For each existing recommendation, we indicate whether it remains the same as in 1998, or whether some changes have been made in either the wording of the recommendation or in the background supporting information.

NEW RECOMMENDATIONS FOR 2000

INFRASTRUCTURE RECOMMENDATION

This recommendation, although not completely new, has been greatly modified from 1998, with Sections A & C removed ,and Section B being re-written.

a) SOIL

ISSUE: **DATA COLLECTION AND MANAGEMENT**

Recommendation #I-A1:

To establish a provincial institute (partnership)composed of MNR, OMAFRA, AAFC and Land Resource Science Dept., University of Guelph, to be responsible for the integrity of soil resource information for Ontario, and having a mandate to improve the quality of the soil resource information database through a program of soil research and data collection, management, analysis and transfer, to a level sufficient for the preparation of official plans, designation of significant/sensitive lands (e.g. prime agricultural lands; prime wetlands; degraded lands; lands posing risk to water quality), and other basic land use planning activities.

ISSUE: **MANURE MANAGEMENT; WATER MANAGEMENT**

Recommendation 1-4: **To quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N.**

ISSUE: **NUTRIENT USE EFFICIENCY**

Recommendation 2-2: **Improving secondary and micronutrient fertilization of field and horticultural crops.**

Recommendation 2-3: **To develop nutrient recycling for greenhouse nursery operations.**

NEW RECOMMENDATIONS FOR 2000 (cont'd)

ISSUE: **SOIL AND CROP MANAGEMENT, NUTRIENT USE EFFICIENCY**

Recommendation 4-4: **To develop and calibrate of multi-element extractants suitable for Ontario soils.**

ISSUE: **SOIL AND CROP MANAGEMENT**

Recommendation 4-5: **To assess the impact of soil fertility and fertilizer additions on the functional food qualities of crops**

ISSUE: **GREENHOUSE GAS EMISSIONS; MANURE MANAGEMENT**

Recommendation 7-2: **To quantify the emission of greenhouse gases from agricultural activities, particularly in relation to manure management.**

ISSUE: **GREENHOUSE GAS EMISSIONS**

Recommendation 7-3: **To quantify the impact, benefits and detriments of climate change and how to adapt to climate change;**

To quantify the impact, benefits and detriments of the Kyoto Agreement and how to adapt its ramifications.

EXISTING RESEARCH RECOMMENDATIONS

A. INFRASTRUCTURE ISSUES

OSWARSC identified a number of infrastructure issues in 1998 which cut across many of the 7 Priority Research Issues around which the 1998 OSWARSC recommendations were organized and which must be properly addressed in order to implement the research recommendations. This report will document progress towards these recommendations, and note significant gaps that persist.

The infrastructure issues are organized as follows:

I. Data Collection and Management.
- **a) Soil**
- **b) Water**
- **c) Air**

II. Scaling (Temporal and Spatial)

I. DATA COLLECTION, UPGRADE, MANAGEMENT AND DELIVERY

a) SOIL

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: **Ontario Soil, Water and Air Research & Services Committee**

OASCC LINKAGES:

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Ontario Ministry of Natural Resources
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Priority: **1-B**

Recommendation #I-A1:

To establish a provincial institute composed of MNR, OMAFRA, AAFC and Land Resource Science Dept., University of Guelph, to be responsible for the integrity of soil resource information for Ontario, and having a mandate to improve the quality of the soil resource information database through a program of soil research and data collection, management, analysis and transfer, to a level sufficient for the preparation of official plans, designation of significant/sensitive lands (e.g. prime agricultural lands; prime wetlands; degraded lands; lands posing risk to water quality), and other basic land use planning activities.

Changes from 1998: **Major changes in this recommendation;**
There has been great progress but the above important issue remains to be properly addressed.

Background: (See Appendix III-1 from the 1998 Report for detailed background)

In the 1998 report OSWARSC raised a number of concerns regarding the integrity and long-term prospects for soil resource data bases maintained by both provincial and federal agencies. With the many cutbacks and re-organizations at both levels, there appeared to be real possibilities that these data bases might actually be allowed to deteriorate until they were no longer useful.

It is quite encouraging to report that there has been a flurry of activities at both levels of government, as well as joint activities, which now have put the data bases and their maintenance on a more sustainable footing.

Refer to Appendix V for further details on the infrastructure initiatives listed below.

I. **Provincial Initiatives**

2. **Cooperative Projects and Endeavours** in Soil and Water Resource Mapping

3. **Federal Activities** - There was a review of the Federal activities during this past fall, during which there was a re-commitment to preserving the CanSIS mapping data bases at the Eastern Cereal and Oilseed Research (ECORC) in Ottawa. There is also a re-organization of Land Resource Units (East and West) in progress, including a more streamlined reporting activity which is centrally located in the Ottawa unit. There has been a considerable effort towards developing detailed 5-year plans outlining priority issues to be addressed. This activity is still in progress.

There has been considerable activity towards addressing the framework and partnership issues.

1. MNR has been given ownership of the electronic soil resource (soil maps) database, and its management.
2. OMAFRA has been given responsibility for the integrity and maintenance of the electronic agricultural soils database, but intends only to ensure that it meets minimum standards. OMAFRA has no plan to upgrade.
3. AAFC- ECORC has voluntarily continued its contributions towards the updating of Ontario electronic soil resource information.
4. OMAFRA is in the process of hiring a 'Soils Information Coordinator' and a 'Data Maintenance Coordinator', and has committed resources since last year to database maintenance.

A framework is being put in place by MNR and OMAFRA to capture the existing agricultural soil resource information (soil maps), maintain it and make it available electronically to users. However, research and improvement (i.e upgrading) of the soil resource database, is lacking. No framework has been put in place, or proposed, provincially to improve the database. ECORC is making some improvements, but only for its own benefit/objectives.

ECORC and Land Resource Science (U of Guelph) seem to be 'out of the loop' of the latest provincial initiatives. It seems to be a province-driven effort, with MNR as the lead. However, they need to be brought in somehow - they are important players.

Provincially-driven efforts are underway towards the 1998 Recommendations A and C (with the noted exception being lack of research and database improvement). There has been no movement towards Recommendation B. MNR should be included in a revised Recommendation B (1998), since it seems to be leading the most recent efforts.

Although it is gratifying to see that considerable progress has been achieved in the Land Resource area this past year, there still remains the very serious issue of **"access to data"**. As the "centralized" data bases are developed by lead agencies, such as MNR, it's not entirely clear as to who has access to the data, and at what cost. It's not entirely clear what access costs may be levied to the original owners of some soils data, if that data has been "enhanced" or" upgraded" by another agency. Beyond this, it is not clear who are the "owners" of enhanced data sets, or whether this ownership is shared amongst agencies who have contributed to the current state that it is in.

On a broader scale, access to data has been greatly reduced since private analytical testing laboratories have come into existence, and where the information collected belongs to the lab and to the submitters, rather than being in the public domain as was the case historically. Furthermore, there often is no centralized control over the experimental or data collection methods to ensure consistency of data quality. There is a great need for a quality assurance program, with reference sample analyses, using standardized protocols.

b) WATER

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: Ontario Water Management Research & Services Committee

OASCC LINKAGES: Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Natural Resources
Canadian Agri-Food Research Council

Recommendation #I-B1: **Develop an agricultural water management data bank.**

Priority: **1-B**

Changes from 1998: **Same Recommendation**

Details:

1. To evaluate the adequacy of available databases for agricultural water management.
2. To survey the available techniques which can be used to develop data bank.
3. To survey the researchers who can contribute to the development of data bank.

BACKGROUND:

Although this recommendation has remained the same for several years, there is a new dimension to it this year, which has been identified in Emerging Issues - that of groundwater aquifer boundaries throughout the province, and their pumping capacities.

The infrastructure aspect of this issue would be the development of groundwater aquifer data bases which organize provincial aquifer information for management purposes. However, at this time it is not clear as to how well the technology for mapping and determining pumping capacities for aquifers has been developed.

c) AIR

ISSUE: **DATA COLLECTION AND MANAGEMENT**

SOURCE: **Ontario Agrometeorology Research & Services Committee**

OASCC LINKAGES: Field Crops Research and Services Committee
Horticulture Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Environment Canada

Recommendation #I-C1: **Maintain and improve the quality and availability of weather data in Ontario.**

Priority level: **1-C**
Changes from 1998: **Same recommendation; new background details**

BACKGROUND:
Uses of weather information for use in Integrated Pest Management (IPM) programs needs to be expanded as IPM models become more refined. In order for IPM programs to function well across large sections of the province, accurate weather information is required on a rather localized basis to make relevant predictions.

At the present time there appears to be considerable inconsistencies in the quality of weather data collected at various locations, and furthermore, there are areas from which little or no weather information is currently collected.

Concern from growers has been expressed over inadequate density of weather stations, especially for rainfall for use in crop insurance models. There is insufficient data, especially precipitation for models, with the Hay model being the worst. There needs to be at least one standard rain gauge reporting for each township. Various types (qualities) of rain gauges are currently used, leading to inconsistencies in data quality. While Atmospheric Environment Services (AES) has volunteer observers in many areas who take temperature and precipitation daily, data from AES has to be purchased.

It would appear that there needs to be a concerted effort to carefully inventory all of the existing weather stations across the province, taking note of the parameters being measured, and the quality of the measurements. When this inventory is complete, then gaps in the network can be identified and an action plan developed to remedy the gaps in the collection network.

II SCALING ISSUE

Background:

Spatial scaling has long been a barrier to accurate interpolations of plot-scale information up to broader-scales, and vice versa. Spatial scaling plays an important role in addressing many current water resources issues (rural-urban water conflicts, manure management, watershed management, selection of best management practices, water requirements for agriculture) as well as the application and interpretation of variable-rate fertilizer technology, or precision application of nutrients in manure. Factors or parameters which are important for describing a situation at one scale, may become unimportant or trivial when observed or measured at a different scale.

Scaling is in fact a science, which requires a thorough understanding of the behaviour of the parameters involved in the particular application at hand.

ISSUE: **SCALING OF DATA**
EVALUATION OF BEST MANAGEMENT PRACTICES

SOURCE: Ontario Water Management Research and Services Committee

OASCC LINKAGES:
TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

***Recommendation II-1*:** **To develop methodology to evaluate the effect of scale (mapping and spatial) on the quantification and management of soil and water resources.**

Priority: **1-A**

Changes from 1998: **same recommendation**

Details:

There is a need for research in the following areas:

1. To describe how the effect of spatial scale (size of water management unit, such as plot, field or watershed and mapping scale of soil, land use) on the nature and management of non-point source pollution..
2. To develop methodologies to spatially scale up the parameters, such as soil, land use land management and climate characteristics, affecting management of soil and water resources.
3. To develop methodologies to scale down the dimensions of the mapping units (such as 1:100,000 or 1:50,000 scale) for the application of tools (models) used for the management of soil and water resources.

BACKGROUND:

There appears to have been no research activity initiated during the past year towards addressing the spatial scaling issue raised in the 1998 report. Although there is very considerable current interest in BMP development, real progress on some of the BMPs appears to be limited until proper spatial methodologies are developed.

As recommended in the 1998 report, **the science of scaling should be the mandate of one of the academic chairs at the University of Guelph.**

1. MANURE MANAGEMENT ISSUE

BACKGROUND:

Manure management continues to be a top priority issue in Ontario Agriculture in1999. Although the commodity prices have rebounded somewhat from1998 levels, they are still depressed, leaving farmers with little extra resources to implement environmental improvements in their operations. Manure management has continued to attract attention in the press throughout 1999. As this report was being prepared, yet another liquid manure spill was reported near Lake Huron in Huron County, where a steady rain followed an excessive field application, resulting in overland flows of the manure into nearby streams leading to the lake. The Environment Ministry had to construct retaining berms to prevent the polluted water from reaching the lake. There have previously been reports of leaking underground manure storages in the area that also resulted in surface and near groundwater contamination.

As a result of the increased awareness in 1998 of the potential long term health implications from endocrine disrupting chemicals (EDCs), a research project involving AAFC and Environment Canada scientists has been initiated, in which the persistence of EDCs in liquid swine manure, following soil application, are being monitored.

Nutrient management planning is being shown to be an effective means for controlling the rates of manure application to soils by setting safe limits for nutrient application, which are based on existing soil nutrient levels as well as on the soil capacity to retain nutrients from leaching. A very successful Nutrient Management Planning Workshop was held in Niagara Falls in March 1999 which was attended by several hundred farmers, extension specialists and researchers.

By April 2000, the NMAN99, the decision support system for manure application developed by Don Hilborn of OMAFRA, and the McCLONE4 software developed by the University of Guelph will be integrated into a single system. The NMAN99 program has become the major regulatory tool for developing nutrient management plans in Ontario and New Brunswick, as well as being used in Manitoba.

Bruce Bowman was appointed the Chair of the CARC Expert Committee on Manure Management (ECMM), which is a sub-committee of the Canada Committee on Natural Resources. Besides providing national coordination on manure issues, the ECMM will provide support for *ManureNet*, the national web site for manure /nutrient issues. Bruce also serves in liaison role with the Federal / Provincial Information Highway Project which is currently developing a national web site for the Canadian Pork Industry, and to which *ManureNet* will be linked.

The Issue Champion Report for Manure Management (Appendix V-1) provides further details of achievements during 1999. Two research recommendations from the strategic 1998 Report have not been changed for this report (1-1, 1-3), one recommendation has been modified (1-2) and a new recommendation introduced (1-4).

ISSUE: **MANURE MANAGEMENT; NUTRIENT USE EFFICIENCY**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research and Services Committee
Field Crops Research and Services Committee
Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Recommendation 1-1: **Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Background:

Although the recommendation remains the same as the 1998 version, the third area of research recommended has been shifted from the P Index (1998) to:

3) Nutrient Release from Manures: The availability of nutrients from manure depends on the mineralization after application, as well as the magnitude of losses. These will both vary with the timing of manure application as well as the weather conditions following application. Better tools for the prediction of available nutrients from manure, particularly N, need to be developed.

Source: Field Crop Sub-Committee
Soil and Water Quality Sub-Committee
Waste Utilization Sub-Committee

There are several research projects addressing this issue. See Appendix IV, Sect. 1 - Manure Management (#1,3, 8, 10); Sect. 6 - Biosolid/Waste Application (#7, 8, 10).

ISSUE: **MANURE MANAGEMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee (ARSC)

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Recommendation 1-2: **Determine the best methods to evaluate the effectiveness of manure treatment technologies, and to develop protocols for evaluating treatment technologies including on-site testing for odours.**

Priority: **1-B**

Changes from 1998: **Recommendation modified**

BACKGROUND:

This recommendation has been changed from a general recommendation on "efficient manure/nutrient management systems for intensive livestock operations" in 1998 to a more focussed recommendation on manure treatment technologies. The recommendation does not involve the "Nutrient Use Efficiency Issue" as in 1998.

A number of technologies are currently being used by farmers as they attempt to do at least one of the following: reduce livestock manure odours, change the form of manure nutrients, reduce the volume of manure produced or break up solids in liquid manure storages. Currently, there are no standard protocols established to determine the effectiveness of these technologies, particularly at the farm level.

Source: Waste Utilization Subcommittee

There is currently one Research Project involving Odour Management (Appendix IV, Sect.1 - Manure Management (#6). There are two projects involving P removal from waste water (#12, 13) and one project involving manure pile runoff (#11).

ISSUE: **MANURE MANAGEMENT; WATER MANAGEMENT**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Animal Research & Services Committee
Engineering Research and Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Health

Recommendation 1-3: **Identification of Sources of Surface Water Contaminants**

Priority: **1-B**

Changes from 1998: **same recommendation**

BACKGROUND:

This recommendation remains the same although the Background information has been updated.

Beach closures are the most visible symptom of bacterial contamination of surface waters, however, it is seldom clear whether the bacterial source is livestock manure, septic tanks, sewage bypass in sanitary sewers, or wildlife droppings. Identifying the source of contamination would allow the targeting of scarce resources to those cleanup and prevention programs that will have the most impact.

Along with bacteria, manure can also contain protozoa (eg. *Cryptosporidium*) and EDC's (Endocrine Disrupting Compounds), although manure may not be the only source of these contaminants. Identifying the sources of these contaminants will have similar benefits.

Source: Waste Utilization Subcommittee

Soil and Water Quality Subcommittee

There are several current research projects addressing this recommendation. See Appendix IV, Sect. 3, Water Management (#2, 6, 7, 8, 12,19), also Sect 1, #14.

ISSUE: **MANURE MANAGEMENT; WATER MANAGEMENT**

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Animal Research & Services Committee
Engineering Research and Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

Recommendation 1-4: **To quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N.**

Priority: **1-A**

BACKGROUND:

This is a new high priority recommendation for the N index, which is required before April, 2000.

Environmental effects of manure may occur on the originating farm, or, more often, away from the farm in downstream watercourses and in the global atmosphere. Research is required to quantify the environmental costs of manure-handling activities to the farmer and to society. Likewise, there is a need to quantify the benefits to society, the costs to the farmer, and the net benefits (or costs) to the farmer and to society of the farmer adopting more environmentally benign manure-handling activities.

Source: Waste Utilization Subcommittee

2. NUTRIENT USE EFFICIENCY ISSUE

Background:

Efficient use of nutrients is key to the profitable and environmentally sound production of crops. Ensuring a sufficient supply of nutrients for optimum crop yield and quality is a relatively straight forward task. This task, however, becomes increasingly complex if the goal is to not to simply optimize yield and quality, but to maximize producer profits and minimize losses to other parts of the environment. Often, nutrients applied in excess of crop requirements are at greater risk of being leached into groundwater, carried with runoff into surface water, or lost to the atmosphere and thereby contributing to greenhouse gas accumulation.

There is a strong basic knowledge about managing nutrients for efficient use, but there are also some significant gaps in our knowledge. These gaps may relate to recommendations for crops which did not receive high research priority in the past, or to entirely new crops. Management practices on farms have also changed, which may require research to keep fertilizer recommendations current, or to at least validate the existing recommendations. New issues, such as greenhouse gases, may also impact on the way nutrients are managed.

Progress and Research Activity in 1999:

Progress continues to be made in the understanding of nutrient interactions in manure, particularly liquid manure, and management to maximize the recovery of nutrients from manure. Research has been initiated to address the question of manure P availability and impact of manure loading rates on soil test P levels. Other projects pertaining to the management of manures can be found in "Manure Management Issue Report" (Appendix V-1).

Several studies have been completed on the nutrient availability from biosolids. These have provided good information about the specific materials studied, but unfortunately the diversity of materials used does not allow direct comparison between different biosolids. Much of this research has been funded by the biosolid generator, and studies are continuing in this area.

Work is continuing in the fertilization of cole crops (N, Ca, S), HRW Wheat (N and use of urease inhibitor 'Agrotain'), muck crops, garlic (foliar sprays), tomatoes, berries crops, apples, grapes and peaches, as well as studies on placement of lime and potash in no-till systems. While some of these studies are just starting, several are well underway and can be expected to yield results in the next year or two.

Barriers to Progress:

While numerous projects are being carried out, the total amount of effort which can be expended on nutrient use efficiency is limited. The number of researchers in nutrient use continues to decline, and those people doing research are only able to commit a small part of their time to research because of other commitments. For example, many of the fertility projects conducted on berry, large fruit and other horticultural crops appears to be only a small component of the over management of these crops. The small number of researchers also limits the opportunities for collaboration and co-operation, making each researcher even less effective.

Sub-issues:

- Horticultural crops - lack of recommendations research, diversity of crops and soils which should each be researched separately still remains an issue.
- Greenhouse gases, and the link to nutrient applications
- Prediction of organic N release - work is progressing in this area for major field crops systems
- Fertilizer applications on sensitive soils
- Nutrient recommendations for specialty crops and new crops
- Validation of recommendations

(Information provided by Dr. I. O'Halloran, Issue Champion). Complete details of the Issue Champion Report are in Appendix V-2).

ISSUE: **NUTRIENT USE EFFICIENCY**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 2-1: **Improving NPK fertility management of corn, cereal crops, canola, horticultural crops and tobacco for increased yield, quality and profitability, and reduced environmental impact.**

Priority: **1-B**

Changes from 1998: **Minor changes**

BACKGROUND:

The first two issues, "Fertility Management on Cereals and Canola" and "Horticultural crops" remain the same. However the remainder has been changed.

3) Corn Nitrogen Requirements: General N recommendations for corn were developed using data from the 1960's and 70's. There is evidence to suggest that the N requirements have increased and that optimum N rates for genetically modified hybrids (eg. Bt corn) may be different. A full review of the general N recommendations is required.

4) Tobacco: Evaluation of nutrient requirements, specifically N and K, on quality and yield of fluecured tobacco: Soil test calibration data used to determine the recommended amount of crop nutrients to apply to a tobacco crop was developed decades ago. While valid at the time, these data are based on field trials using varieties and production practices that are now outdated and were developed to produce a style of leaf now considered undesirable. Growers and researchers alike are concerned about the validity of the current soil test and the effects that imprecise data can have on crop yield, leaf quality and environmental sustainability.

Source: Field Crop Sub-Committee
Horticultural Crop Sub-Committee
Tobacco Sub-Committee

There are numerous research projects identified in the inventory (Appendix IV, Sect. 2, Nutrient Use Efficiency) that are responding to this recommendation.

ISSUE: **NUTRIENT USE EFFICIENCY**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 2-2: **Improving secondary and micronutrient fertilization of field and horticultural crops.**

Priority: **1-B**

BACKGROUND:

There has been an increase in the use of secondary and micronutrients, (both foliar and soil applied) in the horticulture industry. Research is needed to evaluate the effectiveness of these nutrients on the yield and especially quality of horticultural crops.

Boron is occasionally deficient for some field crops in Ontario (particularly alfalfa), while other field crops are highly sensitive to boron and yields are reduced by high boron levels. Research is needed to develop an effective soil test which can be used as a predictor for Ontario soils. Research is also needed into the management of boron for crop production, both in deficient and excess soils.

Although canola growers are experimenting with applying micronutrients, there has been little or no research into the micronutrient requirements of canola.

Calibration research should be conducted with respect to the levels of calcium and magnesium in Ontario soils. There is currently a gap in the data used for recommending calcium and magnesium application to Ontario soils.

Tobacco growers are interested in the effects of calcium when applied at transplanting, side-dressing, and/or as a foliar application with sucker control on agronomic performance including the incidence of bruise green.

Source: Field Crop Sub-Committee
Horticultural Crop Sub-Committee
Tobacco Sub-Committee

ISSUE: **NUTRIENT USE EFFICIENCY**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 2-3: **To develop nutrient recycling for greenhouse nursery operations.**

Priority: **1-C**

BACKGROUND:

The greatest environmental issue of the greenhouse industry is fertilizer leachate. Ongoing research is necessary to determine recycling systems for greenhouse crops that will reduce or eliminate fertilizer effluent from greenhouses.

In the area of flue-cured tobacco seedling production in float trays, determination of methods to utilize nutrient enriched water in an environmentally friendly manner and further investigation on the nutrient requirements for producing high quality seedlings are needed. Other concerns include the effects of various nutrients, including high soluble salts, on seedling germination, growth and hardiness.

Source: Horticultural Crop Sub-Committee
Tobacco Sub-Committee

3. WATER MANAGEMENT ISSUE

Four sub-issues are included under the Water Management Issue:

- **Water Sharing (Quantity)**
- **Water Quality**
- **Water Partitioning**
- **Wetland and Riparian Zone Management**

Background:

In the Backgrounder for the 1998 report, we raised the issue of competition for groundwater in Ontario, in the context of a more variable climate than we have been accustomed to over the past several decades.

Although an "average" amount of precipitation (based on long-term norms) fell on Ontario in 1999, there were tremendous temporal and spatial variations, resulting in serious localized drought conditions, which frequently followed similar conditions in the previous two years. Data supporting climate change models continue to provide fuel for such concern. In May 1999 a moratorium on new Permits To Take Water was issued by the Ministry of Environment (MOE), but in July 1999 this moratorium was lifted. The Ministry of Environment however, continues to curtail the issuance of new permits to take water by imposing a greater amount of scrutiny to each application particularly in areas were low water levels have been an issue in the past.

At the same time that agriculture is starting to experience severe water shortages and use restrictions, our Province is becoming known as a quality exporter of large volumes of bottled water products, which are being globally distributed. Recently, one of Canada's largest water bottlers received permission to extract 176 million L from a spring in Grey County, in the headwaters of the Saugeen River. It was during this past summer that below-normal precipitation in this region caused many wells to go dry and farm ponds to shrink, and in fact parts of Grey County were self-declared to be a drought disaster area. It does not sit well with the agricultural community to see outsiders coming into the community and removing such large volumes of water, despite the contention that less than1% of the Rocky Saugeen's water is being taken.

The *Permit To Take Water Program* has proven to be unreliable during periods of water shortages. The system is complaint driven and sets few priorities beyond domestic, livestock, and emergency water uses. This has the potential for serious conflict in areas where irrigated crops are a major commodity.

The above example is just a single instance of the type of intense competition that will become common place as agriculture, urban and industrial compete for common sources of water. There is an urgent need to develop detailed information on the boundaries, the pumping capacities and recharge rates of our groundwater aquifers in Ontario so that we know their limitations and can plan accordingly.

ISSUE: **WATER MANAGEMENT**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Animal Research & Services Committee
Field Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Ontario Ministry of Natural Resources

Recommendation 3-1: **Determining the Optimal Type, Width and Management of Riparian Buffer Strips to Reduce Sediment, Nutrient and Pesticide Loss into Watercourses**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Details:

There is a need for long-term research in the following areas:

1. To investigate the movement of nutrients in surface and subsurface flows through riparian zones.
2. To investigate the movement of sediments through riparian zones.
3. To develop guidelines for width and vegetative type of riparian zones needed to achieve a predetermined extent of control of site specific (watershed, season and climatic characteristics) non-point source pollution

BACKGROUND:

This is same background information as in 1998 report, with the following addition:

There is a need for research pertaining to:

1. the movement of nutrients in surface and subsurface flows through riparian zones.
2. the movement of sediment through riparian zones.
3. the identification of the adequate combination of width and vegetation type in the buffer strip needed to achieve a pre-determined extent of control of non-point source pollution.

Source: Soil and Water Quality Subcommittee

One research project appears to address this recommendation. (Appendix IV, Sect. 3, #12). There were three grass filter strip projects in Simcoe Co., and York and Durham Regions (Appendix V-3A, Water Issue Champion Report, C. Weil).

ISSUE: **WATER MANAGEMENT**

SOURCE: **Ontario Water Management Research and Services Committee**

OASCC LINKAGES: Engineering Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region;
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment
Ontario Ministry of Natural Resources

Recommendation 3-2: **To quantify water quality functions for Ontario wetlands.**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Details:

To develop water quality indicators that reflect the worth of wetland areas in the Ontario agricultural farmland. Emphasis should be on the role of wetland in the pollution prevention and control practices.

BACKGROUND:

Investigations of OMNR have classified Ontario wetlands as a means to protect sensitive wetland areas. In addition, further joint studies of OMNR / OMEE identified other wetlands that are sensitive but are outside of the protected classes. It was acknowledged that these wetlands play a major role in pollution control by trapping contaminants and sediments from farm drainage runoffs that would normally reach the receiving stream.

Ten demonstration projects under the Green Plan Program focussed on many concerns relating to wetland functions. These relate to, for example, conserving bio-diversity in the ecosystems of Carolinian wetland zone of southern Ontario. The onus is to bridge the need of agriculture, and the need of wildlife and other public interest groups or agencies, who derive benefits from wetlands, such as Ducks Unlimited, OSCIA, Land CARE, etc. We recommend that there should be a concerted effort towards the development of wetland water quality indicators as measures to make sound decisions under those circumstances. The wetland water quality functions should consider physical, chemical, biological, and other ecological features in the development.

See Appendix IV, Sect. 3, #12, 13, 19, 20 for projects related to this recommendation.

4. SOIL AND CROP MANAGEMENT ISSUE

BACKGROUND:

Soil and Crop Management Research in Ontario can be divided into the following research areas:

1. Tillage research to overcome limitations of no-till in clay and clay loam soils
2. Organic amendment applications to improve soil quality by increasing organic matter, improving soil physical properties and/or enhancing nutrient availability.
3. Crop rotation systems to improve soil quality and reduce diseases.
4. Water table management and irrigation technology to alleviate drought stress and thereby improve crop growth, enhance nutrient uptake and/or improve water quality.
5. Greenhouse gas/Carbon sequestration research to improve soil and environmental quality.
6. Soil quality & process studies
7. Site Specific Crop Management

There are at least 7 tillage studies that are being conducted in Ontario to identify and to develop solutions to the problems associated with no-till and conservation tillage systems. For example, zone tillage systems look particularly promising by improving early seedbed conditions while maintaining some of the benefits of a conservation tillage system as about 3/4 of the area is not tilled.

Research using organic amendments has increased to address the viability of using the variety and quantity of composted material available for use on farm land. The desire to increase soil organic matter, to reduce odours (from animal manures such as liquid pig manure) and to divert organic wastes from land fills will result in the increased use of these materials. Research is needed to determine both the short and long-term effects of these composted and organic materials to ensure that food safety, soil, air and water quality are improved. This research area is anticipated to expand over the next decade.

Crop rotation systems have been an integral part of BMPs. In addition to the traditional use of crop rotation systems there has been additional interest in including cover crops such as red clover and cereal rye. Cover crops can be used to increase C sequestration; reduce wind erosion and damage to young seedlings such as tomato transplants; to reduce disease pressure (SCN, P. penetrans, etc.) and to capture residual nutrients such as nitrate in the fall and increase their availability to the subsequent crops.

Water Table Management Systems can be used to overcome dry soil conditions which stress plants and results in lower yields and N uptake. When crop growth is reduced, there is greater amounts of residual nitrate in the soil which could leach out under the wet soil conditions of fall and spring and cause surface and groundwater contamination. A watertable management system can be used to increase crop growth and nutrient uptake and reduce nitrate leaching by about 50%. New fertigation technology is also being used on high valued crops to reduce nutrient leaching and to ensure that these crops have sufficient water and nutrients during the growing season.

The effort towards Site Specific Crop Management (SSCM) has increased during the past 4 years. Initial research efforts have focussed primarily on the issues surrounding variable application of fertilizer nitrogen (N) in corn production systems. Various methods of identifying management units within the field based on crop response to fertilizers (delta yield) and soil N test is ongoing. These studies include an examination of the spatial and temporal yield and delta yield patterns in the field and how they relate to various soil properties, landscape position, land form shape and drainage. These studies have shown that fertilizer N requirements are not directly related to crop yields, and that a greater understanding of yield controlling parameters is needed to implement a successful SSCM plan. (See Appendix V-5 for more details).

Canada's commitment to reducing greenhouse gas emissions will lead to the adoption of soil and crop management practices which increase C sequestration. By increasing soil organic matter, there will be many additional benefits such as improved structure, improved water retention and transmission, increased soil fertility and improved crop productivity. Other approaches to reducing greenhouse gas emissions should also be studied to ensure that agricultural practices contribute to improved environmental quality.

Although OSWARSC does not currently have any research recommendations directly addressing Integrated Pest Management (IPM) issues, they are nevertheless an integral part of some recommendations. In developing the Research Project Inventory, 8 current research projects were classified as 'Integrated Pest Management' and are listed as a sub-set of Soil and Crop Management Projects.

ISSUE: **SOIL AND CROP MANAGEMENT**
NUTRIENT USE EFFICIENCY

SOURCE: Ontario Soil Management Research & Services Committee

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 4-1: **Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.**

Priority: **1-B**

Change from 1998: **Same Recommendation**

BACKGROUND:

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Soil and Water Quality Subcommittee

There are at least two research projects which directly involve spatial considerations (Appendix IV, Sect.4, Site-Specific - #1, 2, 3, 4) and several other projects which deal with this issue to some degree.

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticulture Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 4-2: **Developing crop rotation systems to enhance soil quality and improve crop productivity**

Priority: **1-B**

Changes from 1998: **Same recommendation**

BACKGROUND:

Background item #3 is a new addition for 1999.

The selection of crops within a rotation can play a significant role in the overall productivity and quality of the soil. Recent changes in Ontario have increased the need for research in the following areas:

1) Maximizing Yields Under a Short Term Soybean Rotation:

2) Crop Rotation and Sequence Effects on Soil

3) Cover Crops in Horticultural Systems

Cover crops are still used only rarely in fruit and vegetable production in Ontario. Research is needed to determine the best systems to incorporate cover crops into annual vegetable production systems and to determine the best sequences of crops in these systems. Also, ongoing trials and research are necessary to compare cover crop and organic amendments, and their effects on soil nematode populations.

Source: Field Crop Subcommittee

Horticultural Crops Subcommittee

Soil and Water Quality Subcommittee

Related Research Projects: Appendix IV, Sect. 4 (#6, 7, 9, 10, 11, 12, 14) plus other related projects which involve soil quality (#2, 3, 8, 15, 19).

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 4-3: **Overcoming factors limiting crop production when growing no-till corn and horticultural crops**

Priority: **1-C**

Changes from 1998: **Same recommendation**

BACKGROUND: (changed from 1998)

The adoption of no-till or reduced till appears to have leveled off in the past two years. Some of this can be traced to economics (farmers are more risk averse when commodity prices are dropping or production has been affected by weather). Equally significant are the unanswered questions (real or perceived) concerning management of reduced tillage in specific situations. As the size of farming operations increases, the tendency is to use the "lowest common denominator" (the tillage system which works on the widest range of soils) instead of the most appropriate system for a specific field. This can lead to soil degradation and water quality problems.

1) Fine Tuning No-till Systems: Although there has been much work done relating the effects of tillage systems on the production of crops in Ontario there are still unanswered questions. Producing no-till corn on fine textured, wet soils is still a challenge. The effects of planting in wet conditions with no-till and reduced tillage have not been addressed. Research should be continued on improving the no-fill system and making it more adaptable to specific problem soils.

2) Managing Wheat Residue: Additional research is required to overcome some of the problems with planting no-fill corn after winter wheat. Farmers have identified reduced emergence and plant stands and reduced yields related to growing no-fill corn after winter wheat. Research to investigate residue management after winter wheat should continue. Methods of coping with the increased residue on the soil surface and cooler, moister seedbed conditions must be developed.

3) Lime application: Lime issues related to no-till crop production should also be addressed. Lime is relatively insoluble and immobile in the soil. In no-till production when the option of incorporating lime with tillage is no longer available, the efficacy of lime additions is not well documented.

4) Reduced Tillage Systems for Vegetable Production: In the industry there has been little adoption of reduced tillage systems for vegetable production. Research is still needed to identify the level of tillage reduction and the effect of plant residue on vegetable yields and quality for Ontario conditions and soils.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Soil and Water Quality Subcommittee

Related Research Projects: Appendix IV, Sect. 4 (#4, 5, 6, 7, 10, 11, 13, 16, 25)

ISSUE: **SOIL AND CROP MANAGEMENT, NUTRIENT USE EFFICIENCY**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 4-4: **To develop and calibrate of multi-element extractants suitable for Ontario soils.**

Priority: **1-A**

BACKGROUND:

The current accredited soils tests in Ontario require four different extractions for a basic soil analysis, as well as the use of wet chemistry to measure the concentration of the nutrients in the extract. This adds costs to the operation of a soil test lab, and ultimately to the farmers of Ontario. Other provinces and states are using the Mehlich 3 extractant for soil analysis, but it is not appropriate for Ontario because of the large areas of alkaline soils. Development of a single multi-nutrient extractant for soil testing would be beneficial to both the soil test labs and the farmers of Ontario. Lab procedures would be simplified, leading to lower costs and fewer errors, there would be less toxic waste material produced, and the tests could cover a number of nutrients not currently tested. These developments would help make site specific crop management and manure management more economical.

This research should look beyond traditional soil sampling and analysis. In Quebec and Saskatchewan, development of exchange resin based soil tests is proceeding. Research on environmental impacts of P losses is also revealing alternative tests for soil P that may be more effective in predicting crop P requirements.

Source: Soil Test Lab Subcommittee

ISSUE: **SOIL AND CROP MANAGEMENT**

SOURCE: **Ontario Soil Management Research & Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee
Ontario Food Processing Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario

Recommendation 4-5: **To assess the impact of soil fertility and fertilizer additions on the functional food qualities of crops**

Priority: **1-B**

BACKGROUND:

The growing of crops for their nutraceutical qualities has the potential to be a very lucrative market. Although crops are known to contain different types and levels of nutraceuticals, the impact of management practices on these compounds is not well known. Preliminary results have suggested a positive relationship between soybean isoflavone content and the level of K fertility. Further research is required to determine the influence of fertilizer additions on the functional properties of various food crops (eg. Isoflavones in soybeans).

Source: Field Crop Subcommittee

5. BEST MANAGEMENT PRACTICES ISSUE

Background:

A number of agricultural practices have been postulated in an effort to support environmental responsibility in agricultural production. These practices are most often referred to as "Best Management Practices" or BMPs. A BMP is defined as a practical and affordable approach to conserving a farm's soil and water resources without sacrificing productivity.

The agricultural community has been encouraged to use, and are using, different types of environmentally related BMPs to protect and improve surface and ground water resources on both a farm scale and a watershed scale. Reduction of the entry of phosphorus, nitrogen, pesticides, bacteria and sediment into water resources has been the main focus of the BMPs, as opposed to improvements in crop production or quality.

Many of these BMPs have been incorporated into the Environmental Farm Plan Workbook and are discussed in detail in the Best Management Practices Series. A team of farmers, researchers, natural resource managers, extension staff and agribusiness professionals defined what practices qualified as a BMP.

Most BMPs are based on research findings; however, some have not been tested at various scales and the net effect of combinations of BMPs is unknown. Selection of the appropriate scale for defining and evaluating a particular BMP is a critical step for ensuring the validity of the observed performance of that BMP. Until better scaling methodologies are developed, it will be difficult, and risky to interpret BMP validation data at scales other than at which the information was collected.

There have been a number of financial incentive programs in the past to encourage the adoption of BMPs, and these programs haven't been deemed "successful" in many areas of Ontario. Success has usually been measured in terms of the number of participants, however, rather than by measures of improved water quality. Only in a very limited number of cases has the success of a BMP actually been quantified, either directly in terms of lower concentrations of agricultural pollutants in water, or indirectly in terms of reduced eutrophication of lakes and streams in agricultural areas. In addition, the benefits of BMPs have not as yet been sufficiently quantified to allow either comparison among BMPs, or establishment of the cost effectiveness of BMPs.

Research priorities should focus on:

1. the development of performance indicators that will measure the efficacy of agricultural BMPs for improving water quality on both a farm scale and a watershed scale.
2. To develop statistical and/or risk criteria for predicting the impact of BMP implementation on a farm scale as well as on a watershed scale.

Current Status:

Recently, BMPs have been incorporated into two decision support systems (DSS) for nutrient management planning, NMAN2000 and MCLONE. Municipalities have been and are passing bylaws that require a completed and reviewed nutrient management plan as part of the of the process to acquire a certificate of approval for expansion of operations. Both NMAN2000 and MCLONE operate at the farm and field scale.

Two on-farm, field and farm scale research projects Partners in Nitrogen Use Efficiency (PINUE) and the Ontario Site Specific Cropping Management Project (SSCM) are underway in Ontario. Both are focused on nitrogen use efficiency.

ISSUE: **EVALUATION OF BEST MANAGEMENT PRACTICES; NUTRIENT USE EFFICIENCY; WATER MANAGEMENT**

SOURCE: **Ontario Water Management Research and Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region;
Agricultural Research Institute of Ontario

Recommendation 5-1: **To quantify the effectiveness of various Best Management Practices that are being recommended and implemented by the farm sector to reduce and/or control contamination of surface and ground water resources by agricultural fertilizers (organic and inorganic), pesticides, and sediments.**

Priority: **1-B**

Change from 1998: **Same recommendation**

Details:

1. To develop performance indicators that will measure the efficacy of agricultural BMPs for improving water quality on both a farm scale and a watershed scale.
2. To develop statistical and/or risk criteria for predicting the impact of BMP implementation on a farm scale as well as on a watershed scale.

BACKGROUND:

A project, "Application of Paper Mill Biosolids Benefit Study." (P.Voroney, Univ. of Guelph; Organic Resource Technologies Inc.), is expected to provide critical information in regard to:

2. the optimum application rate of high C:N ratio paper mill biosolids; and
3. the required nitrogen management practices necessary to facilitate decomposition of the biosolids and at the same time not cause soil N depletion or N movement to groundwater.

The Biosolids Utilization Committee is hopeful that the information gained from this study, when available, will be of assistance in the development of a 'Best Management Practices' type information publication for the use of paper mill biosolids on agricultural land in Ontario.

ISSUE: **EVALUATION OF BEST MANAGEMENT PRACTICES; WATER MANAGEMENT**

SOURCE: **Ontario Water Management Research and Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticultural Crops Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affair
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario

Recommendation 5-2: **Development of techniques, practices and amendments that improve water management on fine-textured soils.**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Details:

There is a need to improve water management on fine-textured agricultural soils to reduce the negative impacts of soil water excesses in the spring-fall and soil water deficits in the summer. Research is needed in the following areas:

1. Development of water management practices for fine-textured soils that distribute water more equitably throughout the growing season to reduce the severity and duration of soil water excesses and deficits.
2. Development of water management practices for fine-textured soils that improve the soil water balance through increased infiltration of needed water, faster drainage of excess water, and increased ability of the soil to store crop-available water.

BACKGROUND:

Several research projects in progress may provide important information for this recommendation.

See Appendix IV, Sect 3: #1, 17; Sect. 4: #5, 6, 7, 16, 26.

6. BIOSOLID / WASTE APPLICATION AND TREATMENT ISSUE

Refer to the 1998 report for a detailed Backgrounder on this issue.

Although some progress has been made during the past year on some technical issues involving protocols for developing improved guidelines for utilization of biosolids, there still remains strong concerns and backlash from various citizen groups in the province who are concerned about the way in which biosolid application permits are issued and biosolids applied to agricultural lands.

ISSUE: **BIOSOLID / WASTE APPLICATION AND TREATMENT**

SOURCE: **Biosolids Issue Champion**

OASCC LINKAGES: Field Crops Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee
Rural Community Development Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Ontario Ministry of the Environment
Ontario Ministry of Health
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council

Recommendation 6-1: **To conduct research to quantify short and long-term effects (positive and negative) of land application of biosolids, towards the development of application protocols based on their properties**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Background:

During the past year there has been considerable research activity involving biosolid applications in the province.

There is no indication that any research project has been started specifically for the purpose of developing application protocols.

A two-year project being conducted by P. Voroney, Univ. of Guelph, with Organic Resource Technologies, is studying the impacts of the high C/N ratio of paper mill biosolids, and how much N needs to be added to compensate for this disparity. (Appendix IV, Sect. 6, #8)

A project at Univ. of Guelph, Kemptville, which is optimizing paper mill biosolids application to soil may result in some improved application protocols.

ISSUE: **BIOSOLID / WASTE APPLICATION AND TREATMENT WATER MANAGEMENT; MANURE MANAGEMENT**

SOURCE: **Ontario Water Management Research and Services Committee**

OASCC LINKAGES: Animal Research and Services Committee
Engineering Research and Services Committee
Economics Research and Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
Agricultural Research Institute of Ontario
Ontario Ministry of the Environment

Recommendation 6-2: **To develop practical remedial techniques for managing environmental impacts of existing contamination, and evaluating their economic feasibility.**

Priority: **1-B**

Changes from 1998: **Same recommendation**

Background:

There have been several research projects initiated which are evaluating the agronomic and environmental impacts of biosolids application, although it is not evident that there is an economic assessment component to any of the projects. (See research projects listed in Appendix IV, Sect. 6)

7. GREENHOUSE GAS EMISSIONS ISSUE

Background:

OSWARSC decided that although climatic change is an important issue, that it should not be added as a new Issue for the Committee, but dealt with as an emerging issue. The following backgrounder developed by Dr. Ed. Gregorich, ECORC, AAFC, Ottawa, provides some linkages between the GHG and Climate Change issues.

Agriculture is probably the most sensitive sector to climate change but it is also highly amenable to "intervention". Currently there is a great deal of interest in determining

a) the role that agriculture can play in mitigating climate change,

b) what the impact of climate change on agriculture will be and,

c) how agriculture can adapt to climate change.

Mitigation focuses on measurement of greenhouse gas emissions and carbon sequestration in agroecosystems in order to assess how the sector can reduce the greenhouse effect. Some aspects of mitigation may have important research components which may be of little practical interest to the farmer in terms of best management practices. This may change in the future however, as indicated by the suggestion that utility companies may be willing to purchase of carbon credits from farmers adopting no-till as a offset for their CO_2 emissions. Also, since the Kyoto Protocol requires that Canada reduce its greenhouse gas (GHG) emissions to 6% less than 1990 levels by 2012 and because agriculture is a major contributor of N_2O and CH_4, there may be other governmental 'incentives' for implementation of specific agricultural management systems.

Farmers are interested in knowing what the impact of climate change on agriculture will be and how they will need to adapt their management practices if or when climate change occurs. This area requires scientific investigation with practical outcomes for farmers. Research is needed in a wide range of scientific disciplines including: climate trends and prediction, economics, plant breeding/genetics, soil science, agrometerology, animal science, entomology, and land resource assessment.

Following is a partial list of some research activities that are needed to answer questions in the three main issues related to greenhouse gas emissions and climate change.

Research Objectives for:

1. **Mitigating climate change**

   How can agriculture mitigate the harmful effects of increased greenhouse gas emissions?

   - Investigate the processes involved in GHG production; determine how GHG production is controlled.
   - Quantify the amount of GHG emissions and carbon sequestration in soil from different sources or under various management practices.
   - Scale this information up to a regional/ecozone or national level.

2. **Impact of Climate Change on Agriculture**

   What will be the effect of climate change on crop yields and yield variability?

   Investigate the impact of climate change on:

   - crop yields and yield variability;
   - winter survival of perennial crops and pests;
   - agro-climatic resources, (i.e. heat units, water deficits/surpluses, growing season length, frost-free period, etc)
   - pests and diseases

3. **Adaptation by Agriculture to Climate Change**

   How can agricultural management practices be changed to reduce crop yield losses and yield variability that results from climate change?

   - Investigate impact of various agricultural production and management practices on crop yields, yield variability and productivity under present and climate change scenarios (e.g. 2X CO_2 scenarios) using:
   - controlled greenhouse/lab experiments and in-situ field studies.
   - modelling; either development of new models or adaption/improvement of existing models.

A Status Report of the Climate Change Table, prepared by Maria Alles DeVos, Policy Branch, OMAFRA, can be found in Appendix V-7. An overview of the Options Paper and a table listing Research Priorities for 1999-2000 is presented.

ISSUE: **GREENHOUSE GAS EMISSIONS**

SOURCE: **Ontario Agrometeorology Research And Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

Recommendation 7-1: **To continue to support the measurement and modelling of greenhouse (trace) gases, and to continue the association of this work with research on management systems for nitrogen and organic wastes.**

Priority: **1-B**

Changes from 1998: **Slight change in wording from 1998**

Background:

The recent commitments made by Canada at the Kyoto meetings, and the incomplete knowledge we have about the role of agriculture in the "greenhouse gas" (GHG) problem, make this recommendation a very important issue that should have increased research activity. Separate work has been done on several aspects of this problem, such as carbon sequestration or GHG emissions. Also, different formulations and application methods for nitrogen fertilizers have been considered for their GHG potential, crop response and potential for groundwater contamination. The research now needs to take a more holistic approach to several simultaneous effects that occur in agroecosystems. Specifically:

1) Research is required on the *simultaneous* impact of increased carbon sequestration in soils, soil nitrogen management, and their impact on GHG emissions. There is evidence that greater amounts of soil carbon may increase activity of microorganisms that produce N_2O, thus *enhancing* GHG emissions from the system. N_2O is a more potent GHG than CO_2. Other evidence suggests that greater microbial activity suppresses some soil pathogens and stimulates yield. Thus we have a critical, unanswered question about the *net* effect of storing more carbon and managing nitrogen in agricultural systems. Understanding the ability of selected management systems to manipulate this net effect is a very important current research challenge.

2) Current research to understand N_2O emissions from agricultural systems has required that NO and NO_2 fluxes be measured. The latter gases are also central to the chemistry of ground-level ozone, therefore a spinoff emerging from the N_2O research is a better understanding of the holistic role of agricultural surfaces in regional air quality. Preliminary modelling suggests that agriculture is a strong *sink* for both ozone itself *and its precursors*. Further research with these models is strongly recommended because it is expected to emphasize the value of maintaining agricultural land use as an important tool for air quality management in Ontario

Interestingly, reports exist in the literature about significant production of methyl bromide from canola. Methyl bromide is used as a fumigant (use to be banned by the Montreal Protocol) and bromide is a gas involved in ozone depletion. Our increasing production of canola may be contributing significant amounts of ozone depletion an resultant UVB problems.

There are several research projects listed in Appendix IV, Sect. 7 which address one or more aspects of this recommendation.

ISSUE: **GREENHOUSE GAS EMISSIONS; MANURE MANAGEMENT**

SOURCE: **Ontario Soil Management Research and Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

Recommendation 7-2: **To quantify the emission of greenhouse gases from agricultural activities, particularly in relation to manure management.**

Priority: **1-B**

BACKGROUND:

Agriculture has the potential to be both a source and a sink for greenhouse gases, but the impact of various agricultural activities on the emission of greenhouse gases is largely unknown. There is a need to better understand the role that agriculture plays in the production of greenhouse gases, and the management techniques that could reduce this production. There is an urgent need for information on the emissions of CO_2, CH_4 and N_2O from manure storage (particularly liquid manure storage with crusts) and application.

Source: Waste Utilization Subcommittee

There are three research projects which may address various aspects of this recommendation (Appendix IV, Sect. 7, #3,5,6)

ISSUE: **GREENHOUSE GAS EMISSIONS**

SOURCE: **Ontario Agrometeorology Research And Services Committee**

OASCC LINKAGES: Field Crops Research & Services Committee
Animal Research & Services Committee
Horticulture Research & Services Committee
Engineering Research & Services Committee

TARGET AGENCY: Ontario Ministry of Agriculture, Food and Rural Affairs
Agriculture and Agri-Food Canada, Eastern Region
University of Guelph
Agricultural Research Institute of Ontario
Canadian Agri-Food Research Council
Environment Canada

Recommendation 7-3: **To quantify the impact, benefits and detriments of climate change and how to adapt to climate change;**

To quantify the impact, benefits and detriments of the Kyoto Agreement and how to adapt its ramifications.

Priority: **1-B**

Background:

In addition to developing knowledge on the fundamentals of climate change, work is needed on adapting or production systems to the new realities of a warmer, more variable climate. To do this, the known potential effects of climate change need to be disseminated to production oriented scientists and growers and the public. Climate change is an increasingly important public environmental issue. The climate has been noticeably warming over the past years. Debate and concerns exist about human activities raising the thermostat of the greenhouse we live in.

Regardless of the cause, means to adapt production techniques must be found to enable crop production to be maintained, let alone increased to meet expanding populations. One projection suggests about 48 hot days (>30°C) in the London area as opposed to the 1951-1980 climate normals of about nine days. (Wheaton, PBI Bulletin May 1999). This may even be hotter than the 1999 summer! Estimated changes in the agricultural system by Wheaton include: longer growing seasons, more frequent

droughts and wet spells, more frequent and intense heat waves, fewer cold spells in winter, increased risk of soil erosion by wind and water, decreased snow cover, increasing demands and conflicts over water, decreased river flows and levels, northward expansion of weed, insect and disease ranges, increased disease and pest pressure, decreasing air and water quality. All of the possible outcomes will impact on agricultural production and have to be dealt with.

Many of our horticultural crops, especially vegetables, are cool season species not well adapted to heat, and require considerable water for the yield and quality expected by modern consumers. Interestingly, even a tropical vegetable, sweet potato, *Ipomoea batata*, has been recently shown to respond favourably to cooler soils under no-till culture in the United States. Consider the cole crops (Cruciferae family) for temperature requirements. Cabbage and other cole crops are cool season vegetables. Cole crops usually do best where monthly average temperatures are in the 15.6 - 18.3° C range with an average maximum of 23.9°C. Most do not grow well at temperatures higher than 25° C. For example, cabbage growth (especially late storage types) is arrested at temperatures greater than 25°C. Storage cabbage types grows poorly at higher temperatures. The maximum temperature for cauliflower heading is 20 to 25 °C with an optimum of 17°C. Within the range of 14 - 20°C differences in rate are slight. Quality is lower above 20°C, however cultivar development has reduced sensitivity somewhat. Clearly, hotter summers will have an impact on cole crop production and yield in Canada. Most vegetables require considerable amounts of water, which of course will be affected by greenhouse warming.

Of the areas of study suggested by Wheaton to overcome the effects of climate change, several are clearly crop management related. These include: water conservation, nutrient management, soil conservation, soil management and conservation practices, tillage and harvest practices. One obvious solution for some vegetable crops is no tillage into a killed cover crop systems. Reduced tillage has been accepted for field crops such as corn and soybeans. While work has been done in the USA for some vegetables, little has been done under our conditions. Processing tomatoes have been evaluated under reduced tillage systems in Ontario (McKeown et al 1985, 1995 and Thomas et al 1999). In addition to reducing erosion and costs of production, no till into a cover crop is known to cool the soil and increase soil moisture content making this system an obvious first candidate for adaptation to climate warming. Of course there may be ramifications of no-till and sequestering carbon and greenhouse gasses, as outlined in above priorities. Solutions will have to come from well funded, interdisciplinary teams.

SERVICE RECOMMENDATIONS - 1999

There are seven Service Recommendations which originated in OSMRSC. These recommendations are sent directly from the Sub-Committees to the responsible agency. Recommendations are included in this report for information purposes only.

***Recommendation S-1*: Provide Producers with Available Information about the Establishment and Management of Buffer Strips to Reduce Soil, Pesticide and Nutrient Losses into Adjacent Water Courses.**

Refer to: OMAFRA

Current information regarding design and benefits of buffer strips around ditches and streams should be summarized and put in a format that farmers can access. Information that should be included consists of species, size and specific design criteria to ensure the buffer strip remains effective.

Source: Soil and Water Quality Subcommittee

***Recommendation S-2*: Ensure extension information remains available for the tobacco industry.**

Refer to: OMAFRA Crop Technology

iii) Tobacco Extension Specialists As many new pressures and challenges are facing the tobacco industry, the role of the extension specialists has become increasingly critical. It is vital that OMAFRA maintain the level of service at two-full time extension specialists that have a tobacco mandate and are located in the local area.

ii) Tobacco Extension Support In order to allow the extension specialists to focus on their primary duties of technology transfer, problem identification and grower education, administrative support is necessary. The extension office should be staffed during regular business hours to ensure that growers have full access to the extension services.

Source: Tobacco Subcommittee

***Recommendation S-3*: Water Quality Section should be added to Publication 363, Vegetable Production Recommendations.**

Refer to: Jody Bodnar, editor, Publication 363

The water quality section currently found in Publication 296, Field Crop Recommendations, should also be inserted into Publication 363.

Source: Soil and Water Quality Subcommittee

***Recommendation S-4:* Documentation of the legal aspects of nutrient management planning.**

Refer to: OMAFRA

There are many questions surrounding the legal status of nutrient management plans, particularly with respect to the enforcement of nutrient management plans on an ongoing basis. A study should be initiated to explore what is happening in other jurisdictions, and to document the **successes and** challenges in these other areas as well as within Ontario.

Source: Waste Utilization Subcommittee

***Recommendation S-5:* Increase the availability of information on waste utilization to producers and operators.**

Refer to: OMAFRA, AAFC

There is a need to develop an information sharing system for waste utilization in Ontario, which would document and promote a consistent set of protocols, and general information for a range of clients (researchers, waste generators). This information should be organized an hosted on an existing Internet Web Site, such as the OMAFRA web site, or on the national *ManureNet* web site.

Source: Waste Utilization Subcommittee

Recommendation S- 6: **Provide information to producers on soil compaction caused by land application, and what can be done to alleviate it.**

Refer to: **OMAFRA**

With the use of larger manure tankers for application of liquid manure and biosolids, and the greater number of acres covered, the risk of compaction to many fields increases drastically. Information on methods to alleviate compaction, such as tire selection, drag hoses, low trajectory slingers, need to be summarized and made available to both farmers and custom applicators of manure and biosolids.

Source: Waste Utilization Subcommittee

Recommendation S-7: **Access to Information**

Refer to: OMAFRA (Jim Wheeler)

Every effort must be made to ensure that information that has been developed for farmers in the past, and that will be developed for farmers in the future, remains available to farmers in a format that is inexpensive, easy to get, and widely accessible. This may include ensuring that agricultural offices retain 1-800 phone numbers, keeping the price of publications as cheap as possible and ensuring that there is sufficient staff to service the farmers of the province.

Source: Soil and Water Quality Subcommittee

1999 OSWARSC Report
APPENDICES

Appendix I Sub-Committee Reports I-1
1. Ontario Agrometeorology Research and Services Committee I-2
2. Ontario Soil Management Research and Services Committee I-11
3. Ontario Water Management Research and Services Committee I-32

Appendix II Committee Memberships II-1

Appendix III Committee Terms of Reference and Mandates III-1

Appendix IV Current Inventory of Research Projects in Ontario IV-1

Appendix V Issue Champion & Supplementary Reports (7 reports) V-1
Infrastructure Issue - Soil Resource Management - Larry Schut, OMAFRA V-2
1. Manure Management - M. Goss, Univ. of Guelph V-5
2. Nutrient Use Efficiency - I. O'Halloran, Ridgetown, Univ. of Guelph V-9
3. Water Management
   A. Wetland/Waster Water - C. Weil, Alfred, Univ. of Guelph V-15
   B. General - Tiffany Svensson, Ontario Federation of Agriculture V-25
4. Soil and Crop Management - C. Drury, GPCRC, AAFC, Harrow V-27
5. BMPs - D. Aspinall, OMAFRA V-31
6. Biosolid / Waste Application and Treatment - Larry Schut, OMAFRA V-35
7. Agriculture and Agri-food Table on Climate Change - Maria Alles deVos V-36

Appendix VI Report of Action Taken on 1998 Recommendations VI-1

Appendix VII Summary of Distribution of 1999 Recommendations VII-1

Appendix VIII Coding System for Recommendation Priorities VIII-1

Appendix IX Glossary of Acronyms IX-1

Appendix X 2000 Provisional Meeting Dates X-1

ONTARIO AGROMETEOROLOGY RESEARCH AND SERVICES COMMITTEE

1999 ANNUAL REPORT TO

ONTARIO SOIL, WATER AND AIR RESEARCH AND SERVICES COMMITTEE

November 22, 1999

TABLE OF CONTENTS

Page

Executive Summary I-1

Committee Activities I-3

Action Taken on Previous Year's Recommendations I-5

Recommendations for 1999/2000 ..... I-6

Summary of Distribution of Recommendations I-10

Appendices

i) Terms of reference for OAMRSC ..... Main Report Appendix III

ii) Membership ..... Main Report Appendix II

iii) Available Members Reports

SUMMARY

The annual meeting of the Ontario Agrometeorolgy Research and Services Committee (OARSC) was held at Simcoe on Tuesday November 9 1999. Members present reports indicated that action on last years priorities were ongoing. Grower representatives raised the need for better weather data for IPM, crop insurance etc. Need for more weather based IPM programs was expressed. Holes in the weather radio network need filling. Concern was expressed about identification of air pollution and UVB injury. An emerging concern was adapting production systems to climate change and the Kyoto Agreement. The Ontario Agricultural Weather Services Committee made a presentation to join OARSC. Their original mandate to get weather radio and agricultural weather services going has been completed. They are happy with the system but recognize there are some holes in data and radio coverage. Their interests now are in research and IPM and believed that joining OARSC would strengthen both groups. This was accepted and the OAWSC welcomed OAWSC to join us.

Although progress is ongoing last years overall recommendations are being submitted with some rewording. A new research recommendation was included to address committee concerns about adapting to climate change and the Kyoto agreement.

The 1999/2000 recommendations are:

99-1R. Continue to support the measurement and modelling of greenhouse gasses (trace gasses), and continue the association of this work with research on management systems for nitrogen and organic wastes.

99-2R. Continue to support the development and testing of models to provide " site specific weather" for use in applications such as pest/disease management, crop growth models and irrigation scheduling.

99-3R. Quantify the impact, benefits and detriments of climate change and how to adapt to climate change. As well quantify the impact, benefits and detriments of the Koyoto Agreement and how to adapt to its ramifications.

99-4R. Expand research on diffusion/dispersion modelling in agricultural situations

99-1S. Continue to attack the problem of deteriorating quality and availability of weather data in Ontario.

COMMITTEE ACTIVITIES

The annual meeting of OARSC was held Tuesday, November 9, 1999 at the Simcoe Research Station. Members in attendance were:

Chair: Alan McKeown, U. of Guelph
C. de Leeuw, Campbell Sci.
Chin Tan, Agriculture and Agrifood Canada
Randy Mawson, Environment Canada
Brent Kennedy, OMAFRA
David Wismer, OMAFRA
Tom Jewett, Agriculture and Agrifood Canada
Steven Eastep, Ontario Soil and Crop Association
Murray Brown, U. of Guelph (ret)
Lynn Girty, Ontario Agricultural Weather Services Committee.

Regrets:
Terry Gillespie, Henry Hayhoe

Detailed addresses for all OARSC members are found in the appendices. Reports of agrometeorological activities were heard from attending members and recommendations for 1999/2000 discussed.

Research Reports

Chin Tan. See attached. Tom Jewett was introduced by Chin Tan and requested that Tom take over as the representative from Agriculture Canada, Harrow. The possibility of Environment Canada using Harrow as a climate reference station was discussed. Irrigation of tomatoes after field setting when air is <15^{O}C sets back growth considerably. Climate change and the impacts on water issues were discussed. Water issues will be a real problem as the climate warms.

David Wismer: See attached. The water permits and irrigation situation in 1999 were discussed at length. This issue will have to be addressed. Murray Brown handed out copies several of Estimated Annual Water Surplus for Four regions in Ontario. Uses of weather information and IPM need to be expanded. IPM works in nearby areas and some of the programs can be adapted for use in Ontario. Brent Kennedy stated that OMAFRA was looking for financial support to run weather based services such as IPM programs. Information on cultivar susceptibility to various diseases would be an asset for such models. Concern from growers was expressed over frequency or density of stations, especially for rainfall for use in crop insurance models. There is not enough data for models with the hay model being the worst. There needs to be at least one standard rain gauge reporting for each township. Various types of Rain gauges are used now with some potential for variance in readings. There is also the issue that AES data (eg climate observer) is for sale.

Alan McKeown. See attached. The need for funding for weather station maintenance was discussed. A.E.S. is still surveying autostations in the province. If A.E.S. takes over an existing

Agriculture Canada, U of G or OMAFRA station, the needs of Agriculture need to be addressed in the M.O.U.

Carl de Leeuw. Campbell Scientific has closed the Chatham office and moved al activities to Edmonton. They are setting up a calibration lab for water sensors that previously had to be sent to the USA for calibration. Campbell will be selling a new water level recorder. LIcor sensors still have to be sent to the USA for calibration.

Murray Brown reported that research activities at the University of Guelph listed last year were ongoing. Questions were raised about air pollution injury symptoms and UV injury symptoms. Lynn Girty discussed scab like symptoms on apples that when checked were not fungal scab. Need for a good reference on symptoms of air pollution and UV injury was expressed.

Ontario Climate Advisory Committee. Murray Brown reported that this committee held a workshop in may 1998 on data acquisition. There is a need for a conference on access to data in Ontario.

Ontario Agricultural Weather Services Committee. Lynn Girty brought forward a proposal for this committee to join ours. This committee was formed to promote weather radio and weather dissemination. Weather radio now exists, the committee is pleased with it but do recognize there are holes in the network that need to be filled. Their interests now are research, IPM , access to accurate weather for the above and daily operations. IPM programs need to be expanded. This proposal was discussed Many members are on both but we would want to make sure the grower groups were represented. Also a link to A.E.S. is essential. The committee was unanimously in favour of merging the committees and the chair was directed to send a letter to Lynn Girty to this effect.

Research and Services Priorities

Last years priorities, needs and emerging issues were discussed at length. A number of issues were identified:

Services

- quality of the weather radio network, holes in data and coverage, severe weather broadcasts.
- micro climate issues, especially for Hort crops wrt predictive models, data, reports.
- look across borders for working models.
- diagnostics for environmental damage.

Research

- develop models for other crops for example:
  - IPM,
  - Irrigation,
  - insects, eg corn borer in peppers,
  - not having IPM programs may be barriers to new Pesticide Registration
  - need to verify engines that work models if adapt from elsewhere.

Emerging issues.

- adapting agricultural production systems to climate change
- adapting to the Kyoto Agreement

- carbon sequestering by no-till
- air pollution and UVB burn.

Last years priorities are still valid but can be improved in wording. A new research priority was added.

ACTION TAKEN ON PREVIOUS YEARS RECOMMENDATIONS

The various groups represented at the OARSC have diverse mandates and funding that cover a wide variety of research and service activities. Detailed accounts of activities by those present can be found in the appendices.

98-1R. **Continue to support the measurement and modelling of trace gases, and continue the association of this work with research on management systems for nitrogen and organic wastes.**
See attached report from T. Gillespie.

98-2R. **Continue to support the development and testing of schemes to provide "site-specific weather" for use in applications such as pest/disease management, crop growth models, and irrigation scheduling.**
See attached report from D. Wismer.

98-3R. **Expand research on diffusion/dispersion modelling in agricultural situations.**
Land Resource Science has hired a new agrometeorlogist who is a specialist in diffusion, so activity can be expected in the future in this area.

98-1S. **Continue to attack the problem of deteriorating quality and availability of weather data in Ontario.**

Some meager progress has been made. Environment Canada has surveyed and catalogued all sites in the OMAFRA/U of Guelph network. No decision has been made as to which or any they have any interest.

RECOMMENDATIONS FOR 1999/2000

99-1R. Continue to support the measurement and modelling of greenhouse gasses (trace gasses), and continue the association of this work with research on management systems for nitrogen and organic wastes.

Priority: 1-B

The recent commitments made by Canada at the Kyoto meetings, and the incomplete knowledge we have about the role of agriculture in the "greenhouse gas" (GHG) problem, make this recommendation a very important issue that should have increased research activity. Separate work has been done on several aspects of this problem, such as carbon sequestration or GHG emissions. Also, different formulations and application methods for nitrogen fertilizers have been considered for their GHG potential, crop response and potential for groundwater contamination. The research now needs to take a more holistic approach to several simultaneous effects that occur in agroecosystems. Specifically:

a) Research is required on the *simultaneous* impact of increased carbon sequestration in soils, soil nitrogen management, and their impact on GHG emissions. There is evidence available that higher amounts of carbon in the soil may increase the activity of microorganisms that produce N_2O, thus *enhancing* the emissions of this GHG from the system. N_2O is about 300X as potent a GHG than CO_2 . Other evidence suggests that higher microbial activity suppresses some soil pathogens and stimulates yield. Thus we have a critical, unanswered question about the *net* effect of storing more carbon and managing nitrogen in agricultural systems. Understanding the ability of selected management systems to manipulate this net effect is a very important current research challenge.

b) Current research to understand N_2O emissions from agricultural systems has required that NO and NO_2 fluxes be measured. The latter gases are also central to the chemistry of ground-level ozone, therefore a spinoff emerging from the N_2O research is a better understanding of the holistic role of agricultural surfaces in regional air quality. Preliminary modelling suggests that agriculture is a strong *sink* for both ozone itself *and its precursors*. Further research with these models is strongly recommended because it is expected to emphasize the value of maintaining agricultural land use as an important tool for air quality management in Ontario.

Interestingly, reports exist in the literature about significant production of methyl bromide from canola. Methyl bromide is used as a fumigant (use to be banned by the Montreal Protocol) and bromide is a gas involved in ozone depletion. Our increasing production of canola may be contributing significant amounts of ozone depletion an resultant UVB problems.

99-2R. Continue to support the development and testing of models to provide " site specific weather" for use in applications such as pest/disease management, crop growth models and irrigation scheduling.

Priority: 2-C

It is well known that significant differences in weather occur over short distances in situations such as lakeshore environments and convective rainfall. Good farm management decisions depend on correct estimates of the *local* weather in the near past (for pest/disease or irrigation schemes that depend on antecedent weather) and the near future (for planning farm operations). Support should continue for efforts that are underway (as described above under progress with recommendation 97-3) to develop algorithms that interpolate local, site-specific weather from the available macro and meso scale networks of observing stations. This is a difficult problem which would benefit from additional sophisticated help that could be provided by the meteorological modelling expertise available at Environment Canada. Renewed effort is required to convince EC to participate in a co-operative research program on site-specific weather estimation that partners them with the existing players in U of G/OMAFRA. Ideally, the site-specific antecedent/forecast weather data should be provided by a meteorological model, and U of G/OMAFRA researchers should be providing the "added value" schemes that apply these data to specific farm management decisions.

99-3R. Quantify the impact, benefits and detriments of climate change and how to adapt to climate change. As well quantify the impact, benefits and detriments of the Koyoto Agreement and how to adapt its ramifications.

Priority: 1-B

In addition to developing knowledge on the fundamentals of climate change, work is needed on adapting or production systems to the new realities of a warmer, more variable climate. To do this, the known potential effects of climate change need to be disseminated to production oriented scientists and growers and the public. Climate change is an increasingly important public environmental issue. The climate has been noticeably warming over the past years. Debate and concerns exist about human activities raising the thermostat of the greenhouse we live in.

Irregardless of the cause, means to adapt production techniques must be found to enable crop production to be maintained, let alone increased to meet expanding populations. One projection suggests about 48 hot days (>30°C) in the London area as opposed to the 1951-1980 climate normals of about nine days. (Wheaton, PBI Bulletin May 1999). This may even be hotter than the 1999 summer! Estimated changes in the agricultural system by Wheaton include: longer growing seasons, more frequent droughts and wet spells, more frequent and intense heat waves, fewer cold spells in winter, increased risk of soil erosion by wind and water, decreased snow cover, increasing demands and conflicts over water, decreased river flows and levels, northward expansion of weed, insect and disease ranges, increased disease and pest pressure, decreasing air and water quality. All of the possible outcomes will impact on agricultural production and have to be dealt with.

Many of our horticultural crops, especially vegetables, are cool season species not well adapted to heat, and require considerable water for the yield and quality expected by modern consumers. Interestingly, even a tropical vegetable, sweet potato, *Ipomoea batata*, has been recently shown to respond favourably to cooler soils under no-till culture in the United States. Consider the cole crops (Cruciferae family) for temperature requirements. Cabbage and other cole crops are cool season vegetables. Cole crops usually do best where monthly average temperatures are in the 15.6 - 18.3 °C range with an average maximum of 23.9 °C. Most do not grow well at temperatures higher than 25 °C. For example, cabbage growth (especially late storage types) is arrested at temperatures greater than 25 °C. Storage cabbage types grows poorly at higher temperatures. The maximum temperature for cauliflower heading is 20 to 25 °C with an optimum of 17 °C. Within the range of 14 - 20 °C differences in rate are slight. Quality is lower above 20 °C, however cultivar development has reduced sensitivity somewhat. Clearly, hotter summers will have an impact on cole crop production and yield in Canada. Most vegetables require considerable amounts of water, which of course will be affected by greenhouse warming.

Of the areas of study suggested by Wheaton to overcome the effects of climate change, several are clearly crop management related. These include: water conservation, nutrient management, soil conservation, soil management and conservation practices, tillage and harvest practices. One obvious solution for some vegetable crops is no tillage into a killed cover crop systems. Reduced tillage has been accepted for field crops such as corn and soybeans. While work has been done in the USA for some vegetables, little has been done under our conditions. Processing tomatoes have been evaluated under reduced tillage systems in Ontario (McKeown et al 1985, 1995 and Thomas et al 1999). In addition to reducing erosion and costs of production, no till into a cover crop is known to cool the soil and increase soil moisture content making this system an obvious first candidate for adaptation to climate warming. Of course there may be ramifications of no-till and sequestering carbon and greenhouse gasses, as outlined in above priorities. Solutions will have to come from well funded, interdisciplinary teams.

99-4R. Expand research on diffusion/dispersion modelling in agricultural situations
Priority: 2-B

As indicated in the discussion of last year's recommendations, above, further progress with this recommendation awaits the new faculty person (at U of G) with expertise in this area. The position has been recently filled but the new faculty has had little opportunity to make inroads. The difficulty in filling the available position reflects a small pool of people with the necessary academic background, and the poor current competitive position of Ontario universities with a depressed Canadian dollar and reduced funding for research and infrastructure. However, all the reasons for making this recommendation outlined in our report two years ago, and the subsequent report of OSWARSC, are still valid. Funding should continue to be earmarked to support expanded research in odour and other aspects of diffusion.

Service Recommendations

99-1S. Continue to attack the problem of deteriorating quality and availability of weather data in Ontario.

Priority level: 1-C

a) Continue the process of integrating selected stations from the U of G/OMAFRA weather station network into the Environment Canada network. Beyond the stations chosen by EC for inclusion in their network, decide which additional current U of G/OMAFRA stations need to be maintained to support the agrometeorological research and service mandate in Ontario, and ensure adequate funding is available to provide a level and frequency of maintenance that allows high quality data to be collected at these sites. All these stations would provide input to the local weather estimation algorithms being developed under recommendation 98-2R, above.

b) Develop a data-handling protocol that applies the quality-assurance criteria used by EC to output from the stations that are left to be managed by U of G/OMAFRA. In time, this protocal should be adopted by other groups who maintain their own weather stations and are willing to share data.

c) Support the organization and presentation of a second data workshop, this time concentrating on data *access* for applications. The Ontario Climate Advisory Committee is meeting in November, 1998, to plan this event. They will need support from EC, AAFC, U of G and OMAFRA to engage the appropriate participants and assist with facilities and costs.

Emerging issues.

Water related issues will become more prevalent as the climate warms. Agriculture will be in conflict for water resources with urban, bottled, industrial etc uses, absolute necessity to maintain stream flow for wildlife and so on. Crop insurance claims could well raise dramatically and food security will be impacted. Crop requirements for water is considerable yet rarely taken into account. One hundred bushels/A of corn requires 4.6 to 5.5 million lb of water or 19 to 24 inches of rain. Most cole crops have a high intake of water. Evaporation rates of 4 mm per day have been measured in white cabbage with some higher instances. Water uptake of 0.4 to 0.5 l/plant per day have been measured in adult cauliflowers corresponding to 2 mm of precipitation per day. Red cabbage has been measured with a kg dry matter produced requiring 203 - 840 l of water evaporated. If this rate were translated to a 50t/ha crop of white cabbage we would need 10 to 42 million l of water/ha! (Note, we have varieties capable of over 100 t/ha yields). If we had to grow all of our crops in Ontario with irrigation in a warmer world, the amounts of water would be collossal, notwithstanding the demands on our water by the people to the south. Expansion of irrigation to grow food in a warmer climate will have significant demand on water resources! The conflicting demands of all users may be explosive.

Concern was expressed that lack of weather based IPM programs for all crops might have an impact on pesticide registration in the future. Weather data is required for pesticide registrations and weather stations might have to be GLP compliant.

Adapting agricultural production systems to climate change will be an ever increasing concern if the weather patterns of the last few years continue. Impacts and adaptation of all crops needs to be considered. This needs to be done in cooperation with the basic studies which are also necessary.

Adapting to the Kyoto Agreement. We need to know the potential ramifications to agriculture of this agreement (as well as climate change). The potential benefits and demerits need to be identified and provided to scientists, the industry and the public. This is the first step in identification of how to adapt.

Air pollution and UVB burn. Industry has identified a need for diagnostics and references for both. Increased UVB, human sunburn is getting increasing media coverage. UVB has to have an impact on plants as well. These need to be identified and symptoms, including air pollutants injury provided to growers. For example, Industry representatives reported a scab on apple fruit this year that was non pathogenic. Sprays were made to control scab that was not cased by the scab pathogen. Others have noticed unusual burns on plants in 1999.

SUMMARY OF DISPOSITION OF RECOMMENDATIONS TO AGENCIES

RECOMMENDATION	AAFC	ARIO	OMAFRA	OMEE	EC	U OF G
99-1R Greenhouse gasses	X	X	X		X	X
99-2R Site specific weather		X	X		X	X
99-3R adapt to climate and Kyoto		X	X			X
99-4R Diffusion		X	X			X
99-1S weather data	X	X	X	X	X	X

APPENDICES

MEMBERSHIP - Please see Appendix II, MAIN OSWARSC REPORT

ONTARIO SOIL MANAGEMENT

RESEARCH AND SERVICES COMMITTEE

1999 REPORT TO

ONTARIO SOIL, WATER AND AIR RESEARCH SERVICES COMMITTEE

TABLE OF CONTENTS

Minutes of 1999 Annual Meeting..... I-12

Research Recommendations..... I-17

Service Recommendations..... I-30

OSMRSC Committee Membership..... Main Report Appendix II

1999 Ontario Soil Management Research and Services Committee

Annual Meeting

Minutes

The annual meeting of the Ontario Soil Management Research and Services Committee was held on June 15 and 16 at Guelph Turfgrass Institute.

Attendance:

Ivan O'Halloran	Brent Kennedy	Susan Fitzgerald
Craig Drury	Adam Hayes	Sid Ryzebol
Chris Brown	Tom Bruulsema	Ed Gregorich
Tom Sawyer	Anne Verhallen	Doug Young
Maribeth Fitts	Pat Feryn	Keith Reid
Ron Beyaert	Bill Curnoe	Bob Stone
Papken Bederian	Bruce Bowman	Paul Brine, ERLD

Regrets: John Rowsell, Maria Derkacz

Adoption of 1998 Annual Meeting Minutes: (Ryzebol, Bruulsema) Carried.

Sub-Committee Reports:
Field Crops - Doug Young
Report attached.

Suggested changes to Publication 296: No changes this year.

Motion to accept report: (Young, Curnoe) Carried.

Soil & Water Quality Subcommittee - Tom Sawyer
Report attached.

Tom brought up concerns regarding poor attendance at Soil and Water Quality meetings, but the committee will continue for now. Pat Feryn will be taking over as chairman. Suggested that a representative be added from the Conservation Authorities.

Motion to accept report: (Sawyer, Bruulsema) Carried.

Waste Utilization Subcommittee - Chris Brown
Report attached.

Suggest representation be added from ROMA and BUC. Invitations will be sent for the next sub-committee meeting.

Considerable time and effort has been spent on Nutrient Management Plans - legalities, agronomic implications, Green House Gases. There are questions concerning interpretations

of soil tests - Excessive ratings may be interpreted by non-farmers as being environmentally harmful.

Estrogens in manure could become a concern.

Manure information should be posted on the website (either OMAFRA or AAFC).

Bill Curnoe offered to join the subcommittee if no volunteers are forthcoming from BUC.

Next meeting: March 9, 2000, Husky Farm Equipment, Alma.

Motion to accept report: (Brown, Curnoe) Carried.

Hort Crop Subcommittee - Maribeth Fitts
Report attached.

Maribeth will be stepping down as subcommittee chair, to be replaced by Christoph Kessel.

The committee suggested adding Dr. Tiequan Zhang from AAFC Harrow to subcommittee.

Changes to wording of OMAFRA publications: Moved by Fitts, Bruulsema that "Excessive" rating be reviewed, along with descriptions in the publications to clarify the meaning of this term from agronomic and environmental perspectives. Tom Sawyer moved striking a small committee to suggest changes in wording regarding management when soil test levels excessive. Carried.

Committee: Tom Bruulsema
Bob Stone or Don Hilborn
Keith Reid - chair
Bill Curnoe
Ivan O'Halloran

Committee to have suggested wording ready by September 1 (at the latest) for a fax vote by OSMRSC.

Motion to accept report: (Fitts, Young) Carried.

Soil Test Subcommittee - Papken Bedirian, for Peter Haulena
Subcommittee met in December, and then again by conference call in May.

The subcommittee is working on comparisons of manure analyses between labs, particularly for solid manure.

Research recommendation: that work be undertaken to develop a multi-element extractant that is suitable for the wide range of soils in Ontario, in a matrix which can be used with the ICP spectrophotometer.

Motion to accept report: (Bederian, Drury) Carried.

Tobacco Subcommittee - deferred in the absence of the chair. Ron Beyaert will get a copy of the report and forward it to the secretary for attachment.

Station Reports
TFIO Report - Tom Sawyer
Report attached.

The OSMRSC should compile a list of accomplishments in soil fertility.

Motion to accept report: (Sawyer, Young) Carried.

PPI Report - Tom Bruulsema
Report Attached. Tom pointed out the increased interest in the functional properties of foods, and suggested that this should be used as a lever to get more research funding for soil fertility.

Motion to accept report: (Bruuulsema, Brown) Carried.

Fertilizer Recommendations for Sugar Beets – Anne Verhallen
Report Attached.

Motion to accept the proposed fertilizer recommendations for Sugar Beets (Verhallen, Hayes)

Discussion: The P&K recommendations are based on the old OSMRSC recommendations, adjusted for the use of the sodium bicarbonate extractant. The nitrogen recommendations are based on research done by Michigan State University in the main sugar beet growing area in Michigan, backed up by two years of trial work in Ontario. Concern was expressed that there was insufficient Ontario data to support the proposed recommendations. It was pointed out that the Ontario trials were meant only to assess how well the Michigan recommendations worked in Ontario, and furthermore, that there was no money for further calibration work.

> **Amendment: that the recommendation for an additional 30 kg/ha of N following corn be removed (Young,). Withdrawn for lack of a seconder.**

Motion Carried.

The meeting adjourned for a tour of research sites in the Guelph area. Included on the tour were one of the PINUE sites near Kitchener (with Tiffany Svenson, OFA), the Elora Research Station where we viewed research sites of Paul Voroney, Eric Beauchamp, and Tony Vyn; Claudia Wagner-Riddle showed us her equipment for measuring gas flux from fields at the Arkell Research Station, and Richard Protz's work with imaging and remote sensing at LRS. This was followed by a barbeque at the Guelph Turfgrass Institute, sponsored by OAC and LRS.

16 June, 1999.

Tobacco Subcommittee – Ron Beyaert reported that the chair was unable to attend, but that he will get a report from the chair and submit it to OSMRSC.

Station Reports

Ridgetown College – Doug Young

Doug reported that research is ongoing in the following areas:

- Long term tillage comparisons
- Corn based and soybean based rotations
- Liming in no-till systems
- Site specific cropping
- Composting liquid swine manure
- Cryptosporidium and other contaminants from manure in tile water
- Nitrogen rates on Tomatoes.

Motion to accept report (Young, Beyaert). Carried.

Kemptville College / New Liskeard Research Station – presented by Keith Reid
Reports attached.

Motion to accept report (Reid, Drury). Carried.

AAFC Harrow (GPCRS) – Craig Drury
Report Attached.

Note: AAFC is hosting a Soil Structure / Carbon Workshop in Leamington August 23-25.

Motion to accept report (Drury, Beyaert). Carried.

AAFC Ottawa (ECORC) – Ed Gregorich
Report Attached.

Issues: -CANSIS debating future of soils information database
-AAFC is setting up a working group on Global Warming within Research Branch

Motion to accept report (Gregorich, Drury). Carried.

AAFC London/Delhi (SCPFRC) – Ron Beyaert
Report Attached.

Note: there will be field days at Delhi on July 20-21 (Ginseng, Medicinal Herbs, Soil Management, Tobacco)

Motion to accept report (Beyaert, Young). Carried.

OMAFRA Crop Technology – Brent Kennedy

Some staff changes to report – Bill Ingratta has moved to ERLD, and the position will be filled. Brent Kennedy is now program manager for field crops. Donna Speranzini is now permanently in Duff's Corners as Soil and Crop Specialist.

Land Resource Science – Ivan O'Halloran
Ivan reported briefly on research being carried out in the department:
Bev Kay – least limiting water contents
Paul Voroney – paper mill biosolids
Eric Beauchamp – soil N test
Pieter Groeneveld – baseline nitrate leaching
Michael Goss – manure management
Ivan O'Halloran – P availability from manure, Site Specific Crop Management
Initial results from Site Specific Project: Some sites show very stable yield patterns while others vary from year to year depending on weather. Some sites show no variation in responsiveness although the absolute yield varies. There appears to be some synergy between seed placed and banded P, but not a lot of potential for variable P application.

HRIO – Maribeth Fitts, for Maria Derkacz
Three main projects:

Impact on tree fruit quality of foliar boron applications
Comparison of yield and quality from three different fertilizer regimes – OMAFRA, private consultant, and normal grower program
Nitrogen fertilization for intensive peach production

Balance of the meeting was spent discussing research priorities (attached)

Emerging Issues

1. Lack of personnel at the University of Guelph for Soil Management / Soil Fertility research and teaching.

2. Soil Information Inventory Management

Motion that OSMRSC chair send a letter to AAFC expressing support for the need of maintaining the soils information database (Verhallen, Bruulsema). Carried.

Motion of appreciation for Tom Sawyer (Beyaert, Young). Carried. Chair is instructed to send a letter of appreciation.

Next Meeting: June 13 – 14, ECORC Ottawa.
Note: Include Ed Gregorich on planning conference call.

Thanks were expressed to the Dean of OAC and the Chair of LRS for sponsoring the barbeque.

Motion of adjournement at 12:45 pm (Young). Carried.

1999

ONTARIO SOIL MANAGEMENT RESEARCH RECOMMENDATIONS

***Recommendation* 1:** **Development of better manure and biosolid application systems to improve nutrient efficiency and reduce the impacts on environmental quality**

Priority: **1-B**

Issue: Manure Management

BACKGROUND:

Concentration of the livestock industry into larger production units creates new challenges in manure handling and application. Current research in Ontario addresses many issues associated with manure application, however, some areas of research require much more work. In particular

1) Manure/biosolid application in no-tillage systems or to perennial field crops: With increased adoption of no-tillage systems in Ontario, methods and techniques of applying manure/biosolids to land to maximize the benefits and minimize the losses are required. Conservation tillage systems reduce soil loss and improve the quality of water flowing off of a field. However, losing the ability to incorporate manure may result in more manure remaining on the soil surface which may result in higher nitrogen (N) losses, more odours, potential manure/biosolid runoff and bacterial contamination of surface waters. Additional research is needed to better quantify environmental impacts of surface applied manure (surface runoff, tile drain contamination, volatilization), amount of incorporation that occurs following a rainfall, extent of insect problems (eg. Cutworm) resulting from manure left on the soil surface, and crop yield implications. Research should determine the optimum methods, rates and timing of applying manure/biosolids in reduced tillage systems. This research would benefit farmers trying to incorporate no-tillage practices to save soil and improve soil quality (structure and organic matter) while utilizing manure/biosolids as efficiently as possible.

2) P and K Fertility Levels with Respect to Nutrient Management Plans: Farmers continue to look for opportunities to apply manure/biosolids as a fertilizer source for crop production. Often, many years of over application has raised soil test levels of phosphorus (P) and potassium (K) to what is considered excessive by Ontario Soil Test. There is a need to know what impact of excessive fertility levels, specifically P and K. on agronomic crop production as well as potential environmental consequences. For example, excessive K levels in forages will have an impact on dry cow nutrition, but at what level will high K levels in soil have a detrimental effect on the environment and/or crop yields. The benefit of this research would be to help determine safe manure application rates based on all three nutrients (N, P and K).

3) Nutrient Release from Manures: The availability of nutrients from manure depends on the mineralization after application, as well as the magnitude of losses. These will both vary with the timing of manure application as well as the weather conditions following application. Better tools for the prediction of available nutrients from manure, particularly N need to be developed.

Source: Field Crop Subcommittee
Soil and Water Quality Subcommittee
Waste Utilization Subcommittee

Recommendation 2: **Determine the best methods to evaluate the effectiveness of manure treatment technologies, and to develop protocols for evaluating treatment technologies including on-site testing for odours.**

Priority: **I -B**

Issue: Manure Management

BACKGROUND:

A number of technologies are currently being used by farmers as they attempt to do at least one of the following: reduce livestock manure odours, change the form of manure nutrients, reduce the volume of manure produced or break up solids in liquid manure storages. Currently, there are no standard protocols established to determine the effectiveness of these technologies, particularly at the farm level.

Source: Waste Utilization Subcommittee

Recommendation 3: **Identification of Sources of Surface Water Contaminants**

Priority: **1-*B***

Issue: **Manure Management**

BACKGROUND:

Beach closures are the most visible symptom of bacterial contamination of surface waters, however, it is seldom clear whether the bacterial source is livestock manure, septic tanks, sewage bypass in sanitary sewers, or wildlife droppings. Identifying the source of contamination would allow the targeting of scarce resources to those cleanup and prevention programs that will have the most impact.

Along with bacteria, manure can also contain protozoa (eg. Cryptosporidium) and EDC's (Endocrine Disrupting Compounds), although manure may not be the only source of these contaminants. Identifying the sources of these contaminants will have similar benefits.

Source: Waste Utilization Subcommittee
Soil and Water Quality Subcommittee

Recommendation 4: Quantify the emission of greenhouse gases from agricultural activities, particularly in relation to manure management

Priority: **I -B**

Issue: Manure Management

BACKGROUND:

Agriculture has the potential to be both a source and a sink for greenhouse gases, but the impact of various agricultural activities on the emission of greenhouse gases is largely unknown. There is a need to better understand the role that agriculture plays in the production of greenhouse gases, and the management techniques that could reduce this production. There is an urgent need for information on the emissions Of C02, CH4 and N20 from manure storage (particularly liquid manure storage with crusts) and application.

Source: Waste Utilization Subcommittee

Recommendation 5: Quantify the biological, physical and socioeconomic effects of manure management, in part by developing an environmental index for N.

Priority: 1 -A

Issue: Manure Management

BACKGROUND:

Environmental effects of manure may occur on the originating farm, or, more often, away from the farm in downstream watercourses and in the global atmosphere. Research is required to quantify the environmental costs of manure-handling activities to the farmer and to society. Likewise, there is a need to quantify the benefits to society, the costs to the farmer, and the net benefits (or costs) to the farmer and to society of the farmer adopting more environmentally benign manure-handling activities.

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Source.- Waste Utilization Subcommittee

Recommendation 6: **Improving NPK fertility management of corn, cereal crops, canola, horticultural crops and tobacco for increased yield, quality and profitability, and reduced environmental impact.**

Priority: **1-B**
Issue: **Nutrient Use Efficiency**

BACKGROUND:

Soil fertility research on several crops such as corn, canola, tobacco, horticultural crops and winter wheat is required to optimize nutrient inputs and crop productivity. In particular:

1) Fertility Management on Cereals and Canola: To optimize crop production, more research is required concerning the effects of K top-dressed on winter wheat, canola fertility with N, P and K, and the effects of chloride on cereal yields and quality. There are knowledge gaps in each of these areas.

2) Fertilizer N. P and K Recommendations for Horticultural crop : There has been minimal research in the past for calibration of fertilizer recommendations for horticultural crops grown on Ontario soils. In many of these crops a "best guess" has been used for establishing fertilizer rates or the rates are based on growing old open pollinated varieties. Research is needed to establish "best' fertilizer rates as well as timing for many fruit and vegetable crops.

3) Corn Nitrogen Requirements: General N recommendations for corn were developed using data from the 1960's and 70's. There is evidence to suggest that the N requirements have increased and that optimum N rates for genetically modified hybrids (eg. Bt corn) may be different. A full review of the general N recommendations is required.

4) Tobacco: Evaluation of nutrient requirements, specifically N and K, on quality and yield of fluecured tobacco: Soil test calibration data used to determine the recommended amount of crop nutrients to apply to a tobacco crop was developed decades ago. While valid at the time, these data are based on field trials using varieties and production practices that are now outdated and were developed to produce a style of leaf now considered undesirable. Growers and researchers alike are concerned about the validity of the current soil test and the effects that imprecise data can have on crop yield, leaf quality and environmental sustainability.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Tobacco Subcommittee

Recommendation 7: Improving secondary and micronutrient fertilization of field and horticultural crops

Priority: **1-B**

Issue: **Nutrient Use Efficiency**

BACKGROUND:

There has been an increase in the use of secondary and micronutrients, (both foliar and soil applied) in the horticulture industry. Research is needed to evaluate the effectiveness of these nutrients on the yield and especially quality of horticultural crops.

Boron is occasionally deficient for some field crops in Ontario (particularly alfalfa), while other field crops are highly sensitive to boron and yields are reduced by high boron levels. Research is needed to develop an effective soil test which can be used as a predictor for Ontario soils. Research is also needed into the management of boron for crop production, both in deficient and excess soils.

Although canola growers are experimenting with applying micronutrients, there has been little or no research into the micronutrient requirements of canola.

Calibration research should be conducted with respect to the levels of calcium and magnesium in Ontario soils. There is currently a gap in the data used for recommending calcium and magnesium application to Ontario soils.

Tobacco growers are interested in the effects of calcium when applied at transplanting, side-dressing, and/or as a foliar application with sucker control on agronomic performance including the incidence of bruise green.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Tobacco Subcommittee

Recommendation 8: Prediction of available N from organic materials added to the soil

Priority: **2-C**

Issue: **Nutrient Use Efficiency**

BACKGROUND:

Non-fertilizer sources of N such as manures, cover crops, residues and previous crops all need more research to determine the amount of N being released to the following crop. Appropriate means for predicting the N contributions should also be developed. This is important for all crops, but in tobacco has the added impact on leaf quality.

Source: Field Crop Subcommittee
Tobacco Subcommittee

Recommendation 9: **Develop a nitrate nitrogen test for organic (muck) soils**

Priority: **2-A**

Issue: **Nutrient Use Efficiency**

BACKGROUND:

Research and fields trials are necessary to evaluate and calibrate a nitrate-N test for muck (organic) soils. As well, field demonstrations are needed to evaluate quick test technology for nitrates in both mineral and muck soils. This technology is being used in other parts of the world but has not been well studied in Ontario.

Source: Horticultural Crops Subcommittee

Recommendation 10: **Nutrient recycling from greenhouse nursery operations**

Priority: **1-C**

Issue: **Nutrient Use Efficiency**

BACKGROUND:

The greatest environmental issue of the greenhouse industry is fertilizer leachate. Ongoing research is necessary to determine recycling systems for greenhouse crops that will reduce or eliminate fertilizer effluent from greenhouses.

In the area of flue-cured tobacco seedling production in float trays, determination of methods to utilize nutrient enriched water in an environmentally friendly manner and further investigation on the nutrient requirements for producing high quality seedlings are needed. Other concerns include the effects of various nutrients, including high soluble salts, on seedling germination, growth and hardiness.

Source: Horticultural Crop Subcommittee
Tobacco Subcommittee

Recommendation 11: To investigate the effectiveness of urease inhibitors as a means of increasing fertilizer use efficiency and crop productivity

Priority.- 3-A
Issue: Nutrient Use Efficiency

BACKGROUND:

Ideally none of the inputs used in agriculture should leave the root zone of a field. This, however, is not always the case. Research should be conducted into improving fertilizer efficiency so that nutrients are maintained in the root zone while crop yields are optimized. This includes improving the ability of detecting plant available N from organic sources using soil testing.

Extensive research in the US and Canada has shown significant reductions in ammonia losses from urea using urease inhibitors. Use of these products could assist greatly in matching application rates of urea to crop demand, and reducing losses of N in the form of nitrate as well as ammonia. Further research to support the use of urease inhibitors in Ontario would assist the adoption of such products for use in Canada.

Source: Field Crop Subcommittee

***Recommendation* 12: Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields**

Priority: 1 -B

Issue: Soil and Crop Management, Nutrient Use Efficiency

BACKGROUND:

Field variability of nutrient levels, pH, variable response to fertilizer and yields have created many new challenges to farmers. More research is needed into site specific agriculture that will allow us to predict areas of a field that require higher inputs and areas of a field that require lower inputs. Use of this information may allow us to keep more nutrients in the root zone and may lower cost of production of crops in Ontario. Strategies for optimizing inputs to deal with field variability are needed to optimize production on fields. The variables which affect yield most need to be identified along with cost effective, efficient ways of measuring those variables. With increased use of yield monitors in combines management of soil variability to reduce yield variability is becoming a greater issue.

In an informal study, seasonal fluctuations in soil P, K and pH levels have been observed in Ontario. The magnitude of seasonal fluctuation must be investigated and, if seasonal fluctuation is found, the causes must be studied. It also should be determined if the fluctuations are large enough to affect nutrient recommendations in Ontario and to devise methods of sampling so individual operators can minimize fluctuations in recommendations due to temporal fluctuations in soil test values.

Growers are being bombarded with new technology in the horticulture industry. Research is needed to validate and adapt this new technology which includes such things as remote sensing, GPS mapping and yield monitoring.

Current research in Ontario is concentrating on N and varying N rates across the field. The effects of variable P and K fertilization, planting population, weed control and lime, to name just a few, on yield variability and profitability are currently unknown. Much more needs to be learned.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Soil and Water Quality Subcommittee

Recommendation 13: Crop rotation systems to enhance soil quality and Improve crop productivity
Priority: 2-B
Issue: Soil and Crop Management

BACKGROUND:
The selection of crops within a rotation can play a significant role in the overall productivity and quality of the soil. Recent changes in Ontario have increased the need for research in the following areas:

1) Maximizing Yields Under a Short Term Soybean Rotation: The economic climate in Ontario agriculture makes the growing of soybeans very attractive. Farmers in the province are beginning to grow soybeans in very short rotations (if they use rotations at all). Studies should be run to determine how to best maintain yields of soybeans. How long (or short) should soybean based rotations be to prevent the buildup of pathogens such as rhizoctonia root rot, soybean cyst nematodes, etc.? What is the impact of other rotational crops (such as canola) on soybean yields? Much work was done with corn and many of the problems that were studied for corn must be studied for soybeans as well.

2) Crop Rotation and Sequence Effects on Soil Quality: Many crop rotations and sequences have not been studied. For example, there appears to be reduced yields of many crops grown after canola. Research should be conducted to determine the effects various crop sequences have on overall productivity and sustainability.

3) Cover Crops in Horticultural Systems: Cover crops are still used only rarely in fruit and vegetable production in Ontario. Research is needed to determine the best systems to incorporate cover crops into annual vegetable production systems and to determine the best sequences of crops in these systems. Also, ongoing trials and research are necessary to compare cover crop and organic amendments, and their effects on soil nematode populations.

Source: Field Crop Subcommittee
Horticultural Crops Subcommittee
Soil and Water Quality Subcommittee

Recommendation 14: **Overcoming factors limiting crop production when growing no-till corn and horticultural crops**

Priority: **I -C**

Issue: **Soil and Crop Management**

BACKGROUND:

The adoption of no-till or reduced till appears to have levelled off in the past two years. Some of this can be traced to economics (farmers are more risk averse when commodity prices are dropping or production has been affected by weather). Equally significant are the unanswered questions (real or perceived) concerning management of reduced tillage in specific situations. As the size of farming operations increases, the tendency is to use the "lowest common denominator" (the tillage system which works on the widest range of soils) instead of the most appropriate system for a specific field. This can lead to soil degradation and water quality problems.

1) Fine Tuning No-till Systems: Although there has been much work done relating the effects of tillage systems on the production of crops in Ontario there are still unanswered questions. Producing no-till corn on fine textured, wet soils is still a challenge. The effects of planting in wet conditions with no-till and reduced tillage have not been addressed. Research should be continued on improving the no-fill system and making it more adaptable to specific problem soils.

2) Managing Wheat Residue: Additional research is required to overcome some of the problems with planting no-fill corn after winter wheat. Farmers have identified reduced emergence and plant stands and reduced yields related to growing no-fill corn after winter wheat. Research to investigate residue management after winter wheat should continue. Methods of coping with the increased residue on the soil surface and cooler, moister seedbed conditions must be developed.

3) Lime application: Lime issues related to no-till crop production should also be addressed. Lime is relatively insoluble and immobile in the soil. In no-till production when the option of incorporating lime with tillage is no longer available, the efficacy of lime additions is not well documented.

4) Reduced Tillage Systems for Vegetable Production: In the industry there has been little adoption of reduced tillage systems for vegetable production. Research is still needed to identify the level of tillage reduction and the effect of plant residue on vegetable yields and quality for Ontario conditions and soils.

Source: Field Crop Subcommittee
Horticultural Crop Subcommittee
Soil and Water Quality Subcommittee

Recommendation 15: **Water Table Management for Optimal Crop Production and Environmental Quality**

Priority: **2-B**

Issue: **Soil and Crop Management**

BACKGROUND:

Subirrigation, irrigation, controlled drainage and fertigation all have shown some promise in Ontario. In the past few years, research has been conducted on water table control systems in SW Ontario. Generally the control of water tables consists of lowering the water table to enable planting earlier in the year. Recent results have indicated that controlling water table levels by either raising or lowering the water table, depending on soil moisture conditions, has increased yields of some crops in some years. More research is needed to determine the complete benefits and effects of controlling water tables throughout the growing season in different areas of the province with different climates and crops. More research is needed to determine the economic and environmental sustainability of these crop production practices.

Source: Field Crop Subcommittee
Soil and Water Quality Subcommittee

Recommendation 16: **Management of Organic Matter Amendments on Horticulture Crops, Flue-Cured Tobacco Production Systems**

Priority: **2-C**

Issue: **Soil and Crop Management**

BACKGROUND:

There is ongoing interest in using various organic amendments as part of a crop production system, both by farmers and by the producers of the amendments. There are potential benefits to using these materials, both as a fertilizer and as a way to increase soil organic matter content.

There are, however, potential problems with heavy metals, salts or N tie-up.

Continuing research is necessary to determine the effectiveness and adaptability of these amendments to horticultural production.

Methods must also be developed to evaluate metals and other contaminants in sewage biosolids, paper waste, and manure, including how organic matter affects the transport of contaminants and their uptake by plants.

Source: Horticultural Crop Subcommittee
Waste Utilization Subcommittee

Recommendation 17: **Determining Key Soil Quality *Characteristics for the Development of* Improved Soil Management Systems**

Priority: **2-C**

Issue: **Soil and Crop Management**

BACKGROUND:

Soil quality is a vague and relative term that must be defined and soil chemical, physical and biological attributes must be developed. Soils provide many functions, and when one or more factors are constrained then crop productivity and environmental quality are compromised. A list of key parameters must be established and optimal ranges of measurements defined. For example, physical properties may consist of water transmission rates, storage and aeration status; chemical properties may include total and labile organic matter, etc. Long-term studies could be used to develop and test these biological, chemical and physical indicators and these could then be applied to short term studies to evaluate their potential as a sustainable management tool.

Soil quality should be one of the components of any research into crop management, manure management or tillage systems, so this research can be better extended to other areas and cropping systems.

Source: Soil and Water Quality Subcommittee

Recommendation 18: **Development and calibration of multi-element extractants suitable for Ontario soils.**

Priority: **I -A**

Issue: **Soil and Crop Management, Nutrient Use Efficiency**

BACKGROUND:

The current accredited soils tests in Ontario require four different extractions for a basic soil analysis, as well as the use of wet chemistry to measure the concentration of the nutrients in the extract. This adds costs to the operation of a soil test lab, and ultimately to the farmers of Ontario. Other provinces and states are using the Mehlich 3 extractant for soil analysis, but it is not appropriate for Ontario because of the large areas of alkaline soils. Development of a single multi-nutrient extractant for soil testing would be beneficial to both the soil test labs and the farmers of Ontario. Lab procedures would be simplified, leading to lower costs and fewer errors, there would be less toxic waste material produced, and the tests could cover a number of nutrients not currently tested. These developments would help make site specific crop management and manure management more economical.

This research should look beyond traditional soil sampling and analysis. In Quebec and Saskatchewan, development of exchange resin based soil tests is proceeding. Research on environmental impacts of P losses is also revealing alternative tests for soil P that may be more effective in predicting crop P requirements.

Source: Soil Test Lab Subcommittee

Recommendation 19: **Assess the impact of soil fertility and fertilizer additions on the functional food qualities of crops**

Priority: **I -B**

Issue: **Soil and Crop Management**

BACKGROUND:

The growing of crops for their nutraceutical qualities has the potential to be a very lucrative market. Although crops are known to contain different types and levels of nutraceuticals, the impact of management practices on these compounds is not well known. Preliminary results have suggested a positive relationship between soybean isoflavone content and the level of K fertility. Further research is required to determine the influence of fertilizer additions on the functional properties of various food crops (eg. Isoflavones in soybeans).

Source: Field Crop Subcommittee

Recommendation 20: **Determining the Optimal Type, Width and Management of Buffer Strips to Reduce Soil, Nutrient and Pesticide Loss Into Watercourses**

Priority: **1-B**

Issue: **Wetlands and Riparian Zone Management**

BACKGROUND:

It is well recognized that various agricultural activities have the potential to cause deleterious effects on water quality and on the aquatic habitat, especially stream habitats. These impacts result from input of nutrients, other chemicals, and sediments. In recent years, however, it has been shown that the proper management of buffer strips can substantially alleviate some pollution problems caused by agricultural practices. For example, many researchers have observed that a large percentage of nitrate N in subsurface flow moving towards the stream is removed from the water as it passes through the buffer strip. Similar observations have been made with respect to the sediments in the surface runoff.

Based on such facts, the use of buffer strips has been suggested in the Ontario Environmental Farm Plan and in the Best Management Practices for water and soil management. However, in Canada, research on the effectiveness of buffer strips in reducing non-point source pollution is virtually nonexistent. Management practices should be developed for Ontario soil and climatic conditions. For example, what is the optimal crop species, width and management regime required to control non-point source pollution to a predetermined limit? How should buffer strip width and type be varied With different soil textures and slope conditions? Additional research should be conducted to address these questions for sustainable crop production and improved environmental quality. Some of these basic questions pertaining to the width and type of

vegetation needed to achieve a certain level of nonpoint source pollution control have never been investigated. There is a need for research pertaining to:

1) the movement of nutrients in surface and subsurface flows through riparian zones.

2) the movement of sediment through riparian zones.

3) the identification of the adequate combination of width and vegetation type in the buffer strip needed to achieve a pre-determined extent of control of non-point source pollution.

Source: Soil and Water Quality Subcommittee

ONTARIO SOIL MANAGEMENT SERVICE RECOMMENDATIONS

Recommendation 1: **Provide Producers with Available Information about the Establishment and Management of Buffer Strips to Reduce Soil, Pesticide and Nutrient Losses into Adjacent Water Courses.**

Refer to: **OMAFRA**

Current information regarding design and benefits of buffer strips around ditches and streams should be summarized and put in a format that farmers can access. Information that should be included consists of species, size and specific design criteria to ensure the buffer strip remains effective.

Source: Soil and Water Quality Subcommittee

Recommendation 2: **Ensure extension information remains available for the tobacco Industry.**

Refer to: **OMAFRA Crop Technology**

i) Tobacco Extension Specialists As many new pressures and challenges are facing the tobacco industry, the role of the extension specialists has become increasingly critical. It is vital that OMAFRA maintain the level of service at two-full time extension specialists that have a tobacco mandate and are located in the local area.

ii) Tobacco Extension Support In order to allow the extension specialists to focus on their primary duties of technology transfer, problem identification and grower education, administrative support is necessary. The extension office should be staffed during regular business hours to ensure that growers have full access to the extension services.

Source: Tobacco Subcommittee

Recommendation 3: **Water Quality Section should be added to Publication 363, Vegetable Production Recommendations.**

Refer to: **Jody Bodnar, editor, Publication 363**

The water quality section currently found in Publication 296, Field Crop Recommendations, should also be inserted into Publication 363.

Source: Soil and Water Quality Subcommittee

Recommendation 4: **Documentation of the legal aspects of nutrient management planning.**

Refer to: OMAFRA

There are many questions surrounding the legal status of nutrient management plans, particularly with respect to the enforcement of nutrient management plans on an ongoing basis. A study should be initiated to explore what is happening in other jurisdictions, and to document the **successes and** challenges in these other areas as well as within Ontario.

Source: Waste Utilization Subcommittee

Recommendation 5: Increase the availability of information on waste utilization to producers and operators.

Refer to: **OMAFRA, AAFC**

There is a need to develop an information sharing system for waste utilization in Ontario, which would document and promote a consistent set of protocols, and general information for a range of clients (researchers, waste generators). This information should be organized an hosted on an existing Internet Web Site, such as the OMAFRA web site, or on the national *ManureNet* web site.

Source: Waste Utilization Subcommittee

Recommendation 6: Provide information to producers on soil compaction caused by land application, and what can be done to alleviate it.

Refer to: **OMAFRA**

With the use of larger manure tankers for application of liquid manure and biosolids, and the greater number of acres covered, the risk of compaction to many fields increases drastically. Information on methods to alleviate compaction, such as tire selection, drag hoses, low trajectory slingers, need to be summarized and made available to both farmers and custom applicators of manure and biosolids.

Source: Waste Utilization Subcommittee

Recommendation 7: Access to Information

Refer to: OMAFRA (Jim Wheeler)

Every effort must be made to ensure that information that has been developed for farmers in the past, and that will be developed for farmers in the future, remains available to farmers in a format that is inexpensive, easy to get, and widely accessible. This may include ensuring that agricultural offices retain 1-800 phone numbers, keeping the price of publications as cheap as possible and ensuring that there is sufficient staff to service the farmers of the province.

Source: Soil and Water Quality Subcommittee

Ontario Water Management
Research and Services Committee

1999 Report

to

Ontario Soil, Water and Air
Research and Services Committee

November 23 & 24, 1999

TABLE OF CONTENTS

Summary of Committee Activities I-33

Appendix I Terms and Reference of Committee III-4

Appendix II Committee Membership II-13

Appendix III Agenda of Fall Committee Meeting I-34

Appendix IV List of Projects Related to water Management I-35

Appendix V Minutes of OWMRSC 1999 Annual Meeting I-58

SUMMARY OF COMMITTEE ACTIVITIES

The following meetings were held:

September 27, 1999 Annual Fall Meeting

During 1999 OWMRSC has one regular meetings. This meeting focussed on water management related issues. Last year research and services recommendations were not discussed in detail. There were nine committee members participated in the discussion of water management issues addressed in OSWARSC report.

MEMBERSHIP

One new member, Dr. G. Parkin, from University of Guelph has joined the committee during 1999 OWMRSC annual meeting. Nine members were present and six were absent during the meeting. Every possible effort has been made to schedule the committee meeting to suit member(s) schedule. All the members were contacted by phone. The committee is still concerned about the poor participation from the private sector. This year there was no improvement in the attendance from the private sector, more has to be done. Every committee member has been advised to help in increasing the membership from the private sector by individual contacts.

INVENTORY OF WATER MANAGEMENT RESEARCH

Like last year, the committee decided to keep updating a comprehensive inventory of water management research and services relevant to agriculture in Ontario. Every committee member should submit the updated list of research projects from various organizations/institutes. The detailed listings are similar to previous years, and are available from chair of OWMRSC.

REPORT OF ACTION TAKEN ON PREVIOUS YEAR'S RECOMMENDATIONS

We had not received any information on action taken on previous year's recommendations at the time of our annual meeting.

ONTARIO WATER MANAGEMENT RESEARCH AND SERVICES COMMITTEE RECOMMENDATION TO AGRICULTURE AND AGRI-FOOD CANADA, EASTERN REGION) AND TO AGRICULTURAL RESEARCH INSTITUTE OF ONTARIO

See last year's OWMRSC report

APPENDIX 1 - DUTIES AND TERMS OF REFERENCE
See Page III-4

APPENDIX II - *COMMITTEE MEMBERSHIP*
See Page II-13

APPENDIX III

MEMORANDUM

TO: Members of the Ontario Water Management Research and Service Committee (OWMRSC)

FROM: Chin Tan, Committee Chair

DATE: September 27, 1999

RE: **OWMRSC 1999 Annual Meeting**

A meeting has been scheduled for:

Tuesday, September 28, 1999

10:00 am - 4:00 pm

Room 334- University Centre

University of Guelph

Agenda:

1. Confirm agenda
2. Minutes of last meeting
3. Research inventory
4. Review of 1998 recommendations

e) Water management issues
f) Election of new chair
g) New business
h) Next meeting
i) Adjournment

cst:na
Attach.

APPENDIX IV

List of Projects Related to Water Management

University of Guelph
OMAFRA Environmental and Natural Resources Program

New Projects

Project Title	Name
Prediction of available N from soil organic matter and residual legume crop N	B. Kay
Field techniques for estimating soil hydraulic properties and waste water trench design	D. Elrick, G. Kachanoski
Toxic elements in biosolid amended soils	L. Evans
Development of an analytical support package for farmer groups to implement BMPs for N	M. Goss, G. Thurtell, C. Wagner-Riddle
Evaluation of extraction techniques for estimating potentially available N from manures to crops	M.Goss, L .Evans
Identification of indicator bacteria of rural wells and stratigraphies conductive to bacterial transport	D. Joy
Steady-state baseline N leaching	P. Groenevelt,C. F. Drury, C. S. Tan, W. D. Reynolds
Development of a multi-stakeholder process for resolution of rural-urban conflict over groundwater issues	S. Hilts
Field assessment of leaching bed performance	H. Lee, D. Joy
Detection and Quantification of Cryptosporidium Parium oocysts in water	H. Lee, M.Griffiths, J.Barta, J.Trevor
Performance of wheel and track running gear on liquid manure tankers	R.McBride
Decision support system for manure handling system management	J.Ogilvie
Fertilization recommendations for cabbage production	I.O'Halloran

Influence of management on soil processes and void networks	R.Protz
Correlation of site-specific crop yield data to airborn and satellite imagery	R.Protz
Risk of surface runoff and subsurface drainage from agric regions (ONT)	R.Rudra, M. Goss, G.Kachanoski, C.Wagner-Riddle,H. Whiteley
Diffusion processes within and above tall vegetation	G.Thurtell, C.Wagner-Riddle
Ammonia and N gas Loss resulting from manure application	G.Thurtell, C.Wagner-Riddle
Management of municipal sewage application to agricultural land	P. Voroney
N management for application of food wastes to agriculture land	P.Voroney
N balance of turfgrass	C. Wagner-Riddle, G. Thurtell, G. Kachanoski, D. Elrick
Automated weather station data and numerical weather estimates in crop disease management	T. Gillespie
Integrated Water Management for rural Ontario	R. Kruetzwiser, R. deLoe
Urban-RURAL water conflict: an economic analysis of institutions governing groundwater use in Ontario	K. Rollins, J. Fitzgibbon, G. Fox
Environmental risks, policy changes and resource management in agriculture	B. Smit
Investigations of riparian buffers and wetlands for management of agricultural non-point source pollution	N. Kaushik, A. Gordon, R. Rudra, H. Whiteley, R. McBride
Improvements in modelling P dynamics in wetlands	I. Heathcote
Amelioration of nitrate-contaminated groundwater in rural Ontario	W. Chesworth

Projects Carried Forward

Fate of Agricultural Site Specific Crop Management	G. Edwards, I. O'Halloran, R. McBride, R. Protz
Manure systems project	M. Goss, C. Wagner-Riddle, C. deLange

UNIVERSITY OF GUELPH - Department of Land Resources Science

Title of Research Project	Principle Investigator	Funding Agency
Denitrification of soils	E.G. Beauchamp	NSERC
Manure N availability	E.G. Beauchamp	NSERC
Nitrogen dynamics	E.G. Beauchamp	INCO, NSERC Agriculture Canada
N_2O emission in intensive crop	E.G. Beauchamp	Agriculture Canada
Nitrate supply from manure	E.G. Beauchamp	OMAF, EYCP
Transport phenomena in natural porous media	D.E. Elrick	NSERC
Field technique for measuring the hydraulic conductivity of soils	D. E. Elrick	OMAF
Pressure infiltrometers	D. E. Elrick	NSERC
Manure management to sustain water	M.J. Goss	Agriculture Canada
Literature search on mature nutrient management	M.J. Goss	Agriculture Canada
The transformation rate of inorganic nitrogen in animal manure into plants and soil organic matter and its subsequent re-release from soil organic matter	M.J. Goss	Agriculture Canada
To identify the seasonal variations in well-water contamination and survey the health of farm families drinking water contaminated with nitrate and bacteria	M.J. Goss	Agriculture Canada
Metal retention by soils	L.J. Evans	NSERC
Phosphorus release and crop residue management	L.J. Evans	TED-SWEEP Agriculture Canada
Retention of toxic metals by soils	L.J. Evans	OME
Modelling of Chromium retention in soils	L.J. Evans	NSERC

The nature of soil test extraction	L.J. Evans	Potash Phosphorus Institute
Soil hydrological properties under different management practices	P.H. Groenevelt	EIUDR/CIDA
Evaluations of soil additives to reduce soil erosion	P.H. Groenevelt	OMAF
Modelling of soil erosion	P.H. Groenevelt	OMAF
The influence of clay mineralogy	P.H. Groenevelt	CIDA
The relation between the rates of infiltration and erosion	P.H. Groenevelt	CIDA
Development of a reliable waste disposal system for milkhouse	P.H. Groenevelt	OME
The relation between aggregate stability and run-off and erosion	P.H. Groenevelt	WUSC,CIDA
Tillage effects on the spatial and temporal variations of the soil properties	R.G. Kachanoski	NSERC
Variable rate technology for fertilizer nitrogen application	R.G. Kachanoski	Agriculture Canada
Impact of livestock manure & fertilizer application on nitrate of ground water	R.G. Kachanoski, E.G. Beauchamp	O.M.E.
Landscape position	R.G. Kachanoski	Agriculture Canada
Crop productivity and soil loss in variable topography	R.G. Kachanoski	OMAF
Prevention of nitrate contamination of ground water from fertilizer	R.G. Kachanoski	OMAF
Tillage effects on transport processes in soils	R.G. Kachanoski	NSERC
Heat and mass transfer in soils	B.D. Kay	NSERC
Role of environmental factors and land management on soil structure	B.D. Kay	NSERC
Influence of soil texture and tillage practices on susceptibility of legume nitrogen to leaching	B.D. Kay	Agriculture Canada

Measurement of nutrient transport and agricultural pesticides from cropland	B.D. Kay	Agriculture Canada
Soil stewardship cropping systems for corn and soybean production in Ontario	B.D. Kay, R. Sheard, T. Vyn	OMAF
Methodologies for assessing soil structure and prediction of crop response to changes in soil quality	B.D. Kay	Agriculture Canada
Slow rate infiltration land treatment and recirculation of landfill leachate in Ontario.	R.A. McBride, L.J. Evans, A.M. Gordon, P.H. Groenevelt, T.J. Gillespie	OME
Waste water recycling	R.A. McBride	MPAF, EYPC
Soil compaction research	R.A. McBride	OMAF, EYPC
Wastewater management research	R.A. McBride	OMAF, EYPC
Characterization of soil compaction and its agronomic significance	R.A. McBride	NSCP, Agriculture Canada
Soil compaction risk assessment for corn production in the Regional Municipality of Haldimand-Norfolk	R.A. McBride	NSCP, Agriculture Canada
The use of cover crops for nutrient conservation	M.H. Miller, E.G. Beauchamp, R. P. Rudra, T.J. Vyn	TED-SWEEP, Agriculture Canada
Nitrogen and Phosphorus management in no-till corn production	M. H. Miller	OMAF
Remote sensing of wetland	R. Protz	NSERC-CIRAC
Development of a system for land use monitoring for Ontario	R. Protz	Agriculture Canada
A comprehensive image analysis system for studies of soil processes	R. Protz	NSERC
Ground based radiometer for water resources assessment	R. Protz	Ins.Space & Terr/ Sci.
Image analysis for study of soil processes	R. Protz	OMAF
Application of organic wastes to agriculture land	R.P. Voroney	OMAF

School of Engineering

Integrated NPS-GIS model	W. T. Dickinson, R. P. Rudra et al.	GLURF
Mechanics and modelling of soil erosion	W.T. Dickinson	NSERC
Transport of pesticides through porous media	D. Joy	NSERC
Analysis of a small gauging network in Ontario	H.R. Whiteley,D. Joy & W.T. Dickinson	
Mechanics and modelling of drainable water quality	R.P. Rudra	NSERC
Integrated non-point source model for farm planning	W.T. Dickinson, R.P. Rudra et al.	NSERC
Development of erosion control indices for erosion control ditch liners	W.T. Dickinson, R.P. Rudra & S.C. Negi	OMTC
Surface water quality modelling	W. James	NSERC
Operating modelling of phosphorus	P.S. Chisholm	SWEEP-TED
Integrated non-point source model for watershed planning	R.P. Rudra and W.T. Dickinson	OME
Modelling the transport of gasoline in unsaturated soils	R. Zytner	U of G
Bacteria transport through soils	H. Lee, D. Joy et al.	OME
Water runoff from highways	H.R. Whiteley, R. Corci	OMT
Mathematical modelling of preferential flow	R.P. Rudra and W.T. Dickinson	GLURF
Quantification of preferential flow by constructive methods	R.P. Rudra and W.T. Dickinson	GLURF
Development of tools for prediction of sediment from highway construction sites	W.T. Dickinson and R.P. Rudra	OMT
Development of ditch erosion indices ditch erosion	W.T. Dickinson and R,P, Rudra	OMT

Canada-Ontario Green Plan

Project Title	Institution/Organization
Current state of the art on manure/nutrient management (complete)	M. Goss, Land Resources Sci., University of Guelph, Guelph, Ontario
Nitrogen and carbon transformation in conventionally handled livestock manure	G. Kachanoski, Land Resources Sci., University of Guelph, Guelph, Ontario
Manure composting techniques: Understanding N and C conservation	R. St. Jean, Ecologistics Ltd., Waterloo, Ontario
Transformation in soil: Crop response to nitrogen in manure with widely different characteristics	E.G. Beauchamp, Land Resources Sci., University of Guelph, Guelph, Ontario
Impact of manure application methods on water quality, focussing on nitrogen and bacteria transport in soils	G.J. Wall, Agriculture and Agri-Food Canada, Ontario Land Resource Unit, Guelph, Ontario
Closed loop recycling - Composed biodegradable organic urban waste application on agricultural lands	D. Charlton, Ecological Services for Planning, Guelph, Ontario
Literature review of on-farm research design and data evaluation methods	Jane Sadler-Richards, Ecologistics Ltd., Waterloo, Ontario
Investigating methods of integrating liquid manure into s cropping system and the effect on soil and water quality	D. Charlton, Ecological Services for Planning, Guelph, Ontario
Environmental effects of conservation and conventional cropping systems	Jane Sadler-Richards, Ecologistics Ltd., Waterloo, Ontario
To obtain information on variable rate technology for nitrogen application and determine the feasibility of implementing the production tool	G. Kachanoski, Land Resources Sci., University of Guelph, Guelph, Ontario
Measuring the effect of crop residue or live cover crop in conservation tillage on soil and water quality	C. F. Drury, Agriculture and Agri-Food Canada, Greenhouse & Processing Crops Research Centre, Harrow, Ontario
Crop rotation and crop cover effects on erosion control, tomato yield and soil properties in Southwestern Ontario	K. Stevenson and R.W. Johnson, Ridgetown College of Agricultural Technology, Ridgetown, Ontario
Development of standard methodologies: Residue biomass and organic carbon (complete)	D. Charlton, Ecological Services for Planning, Guelph, Ontario
Development of standard methodologies: Residue biomass and organic carbon (complete)	G. Kachanoski, Land Resources Sci., University of Guelph, Guelph, Ontario

Development of standard methodologies: Bio-indicators and methodologies to quantify soil quality	C.M. Montreal, Centre Experimental farm, CLBRR, Ottawa, Ontario
Assessing the state of agricultural resources: Improving the land resources database (complete)	D. Cressman, Ecologistics Ltd., Waterloo, Ontario
State of resources: Proposal for upgrade of soil survey information in Oxford County (complete)	D. Charlton, Ecological Services for Planning, Guelph, Ontario
State of resources: Development and application of standardized methodology for sampling soil landscape polygons (complete)	J. Hagarty, Ecological Services for Planning, Guelph, Ontario
State of resources: Development and testing of "State of agricultural resources". A reporting and monitoring methodology for Ontario (complete)	Harold Moore, Gregory Geoscience Ltd., Kanata, Ontario
State of resources: Monitoring soil loss and redistribution using ^{137}Cs (complete)	G. Kachanoski, Land Resources Sci., University of Guelph, Guelph, Ontario
State of Resources: Improving the land resource database - Waterloo region	D. Cressman, Ecologistics Limited, Waterloo, Ontario
Development and application of a computerized system to manage, use and distribute data collected by Green Plan Research projects	K. Denholm, Agriculture and Agri-Food Canada, Ontario Land Resource Unit, Guelph, Ontario
Partitioning of solute from agricultural fields within the hydrologic system at two sites in Southern Ontario and subsequent impact on adjacent aquatic ecosystems	D. Rudolph, Waterloo Centre for Ground Water Research, University of Waterloo, Ontario
Effect of controlled drainage/subirrigation on tile drainage water quality and crop yield at the field scale.	C. S. Tan, Agriculture and Agri-Food Canada, Greenhouse & Processing Crops Research Centre, Harrow, Ontario
Soil organisms as bioindicators of agronomic practices	A. Tomlin, Agriculture & Agri-Food Canada, Pest Management Research Centre, London, Ontario
A literature review on wildlife habitats in agricultural landscapes (complete)	L. Friesen, Canadian Wildlife Service, Environment Canada, Hull, Quebec
Assessment of the influence of manures for the control of soilborne pests including nematodes, fungi and bacteria	G. Lazarovits, Agriculture and Agri-Food Canada, Pest Management Research Centre, London, Ontario

Measuring soil microbial populations by analysis of their phosphalipid signatures	R. Chapman, Agriculture and Agri-Food Canada, Pest Management Research Centre, London, Ontario
Determining the factors responsible for, and methods to overcome the limitations of conservation cropping systems on clay soils	T. Vyn, Crop Science Building, University of Guelph, Guelph, Ontario

Essex Region Conservation Authority Projects Relating to Water Management

1. Constructed wetland for milkhouse wastewater treatment. Janice LeBoeuf, Soil and Water Conservation Technician ERCA (Partners: ERCA, MOEE (CURB))
2. Wetland to polish urban stormwater. StanTaylor ERCA (Partners: McLaren's Engineering, LCBA, ERCA)
3. Wetland to polish landfiil stormwater runoff. Stan Taylor ERCA (Partner's: Proctor and Redfern, EWSWA, ERCA)
4. Turkey Creek channel improvements. Stan Taylor ERCA (Partners: McLaren's Engineering, LCBA, City of Windsor, Town of LaSalle, ERCA)
5. Little River Habitat Rehabilitation: Re-establishment of natural floodplain, naturalization of stream bank, stormwater management. Jim Hartman ERCA (Partners: City of Windsor, Great Lakes 2000 Cleanup Fund, ERCA)
6. Conservation Biodiversity Strategies for the Point Pelee/Hillman Marsh and Detroit River greater Area of Concern Sub-watersheds. Dan Lebedyk, Biologist - Project Co-ordinator ERCA Ongoing

Ridgetown College of Agricultural Technology

1. Crop Rotation effects on crop yields and soil properties in southwestern Ontario: A) to study the effects of the time of red clover plowdowns; and B) to study the effects of different crop rotations; K. Stevenson, D. Young.
2. Flood-water storage as a flow control in small watersheds; J. Johnson, B. Stone, D.Hilborn

Alfred College of Agricultural Technology

1. Drainage of heavy clay soils in Prescott-Russel; C. Weil, K. Wires, S. Natho-Jina
2. Mole drainage, C. Weil, K. Wires, S. Natho-Jina

Agriculture Canada Research Branch

1. Soil conserving production systems; J. Culley, R. de Jong,S.U. Khan, **C.** Fox, G.C. Topp, L.M. Dwyer, H.N. Hayhoe
2. Water and solute movement in structured soils; D. Reynolds and **G.C.** Topp
3. Kapaskasing drainage project; Water table management in varied clay soils; K. Wires and J. Prouix
4. Pesticide residues in agricultural drainage water and soils; **N.K.** Patni
5. Effect of livestock manure application and management on surface water quality. G. J. Wall and D. King **(CLBRR Guelph)**

6. Occurrence and fate of selected agricultural pesticides in near-shore zones of the Great Lakes: J.A. Millette **(CLBRR Ottawa)**
7. To describe and quantify the impact of agricultural land management on surface and ground water quality with a view to mitigating its effects: J.A. Millette **(CLBRR Ottawa)**
8. To determine the heavy metal count following the use of cement kiln dust in water, soil and food quality: R.B. Simard **(Ste-Foy Research Station)**
9. To measure historical erosion rates within a water basin. A. Pesant **(Lennoxville Research Station)**
10. To compare the effects of seasonal (fall and spring) applications of hog manure on water quality. A. Pesant **(Lennoxville Research Station)**
11. Establish nutrient input output balance. A. Pesant **(Lennoxville Research Station)**
12. To determine the impact on the nitrogen needs of corn, and nitrogen movement to ground water. R.B. Simard **(Ste-Foy Research Station)**
13. To measure the quantity and quality of run off (for nutrient and phosphorus) on an agricultural watershed. A. Pesant **(Lennoxville Research Station)**
14. To measure the effect of different types of fertilizer, cropping and tillage practices on soil and water nutrient dynamics. R.B. Simard **(Ste-Foy Research Station)**
15. Review of research on ground water contamination from non-point sources in the Great lakes basin. J.A. Millette **(CLLBRR)**
16. Development of criteria to determine which pesticide classes pose a threat in runoff water to the Great lakes environment. A.S. Hamill **(Harrow Research Station)** - Completed.
17. Reduced chemical input systems for field crops to improve water quality. J. Culley **(CLBRR, Ottawa)**
18. determination of migration rates of agricultural chemicals through soils of Great Lakes basin. R. De Jong **(CLBRR, Ottawa)**
19. Estimation of atmospheric transfer of agri-chemicals affecting Great lakes water quality. R. Desjardins **(CLBRR, Ottawa)**
20. Physical chemistry parameters controlling pesticide persistence and leaching in agricultural soils. D.S. gamble **(CLBRR, Ottawa)**
21. Fate of agricultural chemicals in soil, ground water and drainage water, under farm conditions. N.K. Patni **(Cente for Animal Research)**
22. Identification and distribution of arthopods in seeps, springs, first and second order streams and biomonitoring of agricultural activities. D.R. Oliver **(CLBRR)**

23) To reduce herbicide/nitrate losses through runoff in tile drainage through, among others, controlled water table systems (reducing tile drainage during certain periods. C.S. Tan, C. F. Drury, J.D. Gayner, T.W. Walachy **(Harrow Research Station)**

24) Influence of conservation tillage on nitrate loss. C. F. Drury **(Harrow Research Station)** - Completed

25) Transport and dissipation pathways of pesticides in upland watershed employing applying conventional and conservation tillage in Ontario. B. Bowman **(London Research Station)**

26) To develop and recommend remedial measures for reducing pesticide transport for surface and ground water from agricultural lands. B. Bowman **(London Research Station)**

27) Measuring the effect of crop residue and live cover in conservation tillage systems on soil and water quality. C.F Drury, C. S. Tan, A.S Hamill, S.E Weaver and T.W. Walacky **(Harrow Research Station)**

28) Effect of water table control and N-supply on nitrate and herbicide losses. C.S. Tan, C.F. Drury and J.D. Gayner **(Harrow Research Station)** - Completed

29) Influence of tillage on nitrate loss in surface runoff and tile drainage. C.F. Drury, J.D. McKenney, A.I. Findley and J.D. Gayner **(Harrow Research Station)** - Completed

30) Effect of conservation and conventional tillage with/without subirrigation/controlled drainage on greenhouse gas emission from corn production systems. D.J. McKenney, C.F. Drury and C.S. Tan **(Harrow Research Station)**

31) Effect of controlled drainage/subirrigation on tile drainage water quality and crop yield at the field scale. C.S. Tan, C.F. Drury, J.D. Gayner, M. Soultan and T. Welechy **(Harrow Research Station)**

32. Effect of yard waste compost on field crop production and soil and water quality in farm-scale under no-tillage and conventional tillage. C. S. Tan, C. F. Drury, W. D. Reynolds, J. D. Gaynor and T. Q. Zhang. **(Harrow Research Station)**

33. The effect of fertilization and crop rotation on soil and water quality. C. F. Drury, C. S. Tan, W. D. Reynolds **(Harrow Research Station)** and P. Groenevelt **(U. Of Guelph)**

Queen's University, Kingston

1. Impacts of tile drainage on land phase of the hydrologic cycle; W.E. Watt, J.P. Paine
2. The effects of agricultural drainage on sediment and water quality loadings; J.D. Paine, S.A. Peters, W.E. Watt

University of Windsor

1. Testing integrated water quality models; M. Sklash
2. Use of environmental isotope tracers to determine the role of macropores and high permeability zones in groundwater recharge and movement; M. Sklash - Completed
3. Storm runoff generation in fractured clay soils. M. Sklash and M. Huang
4. Hydrogeological implications of a buried linear morphological feature in Essex county, Ontario. M. Sklash and K. Chekiri.
5. Improved method of monitoring well installation in fractured clay. M. Sklash and C. Hudec - Completed

Horticulture Research Institute of Ontario, Simcoe

1. Trickle irrigation studies for horticultural crops; Cline, Reissman, Tehrani, miles, Fisher, Dale
2. Irrigation of size controlled apple trees; Elfving

Environment Canada, CCIW. Burlington

1. Atrazine and metalachlor loadings in a paired watershed (Kintore Creek); J. Struger
2. Herbicide levels in precipitation in southern Ontario (Pelee I.); J. Struger

3. Assessment of the impacts of agricultural pesticides on wetlands in southern Ontario; J. Struger
4 Development and integration of pesticide use, agricultural crop, and soil type data bases with water quality data bases; J. Struger
5. Agricultural non-point sources of contaminants and modelling; H. Ng.

PROJECTS FUNDED UNDER SWEEP PROGRAM

	Title of Research Project	Institution/Organisation
1.	The Effect of Terraces on Phosphorus Movement.	Ecologistics Ltd., Waterloo, Ontario
2	Effects of Subsoiling on Corn Yields and Soil Conditions in Southwestern Ontario.	Can-Ag Enterprises, Guelph, Ontario
3	Effect of Ammonia On Soil Properties and Relevance to Water Quality.	Ecologistics Limited, Waterloo, Ontario
4	Effects of Management on Surface Hydraulic properties.	University of Guelph, Guelph, Ontario
5	The Effect of Organic Mulches on Soil Moisture and Crop Growth.	University of Guelph, Guelph, Ontario
6	Optimal Herbicides Use in Conservation Tillage Systems.	Ridgetown College of Agricultural Technology Ridgetown, Ontario
7	Survey of moisture Distribution Between Tile Drainage Laterals and its relationship to compaction and Rooting Depth in flat Clay Soils.	Strata Engineering, Mississauga,Ontario
8	Nutrient Distribution and Stratification Resulting from Conservation Farming.	Ecologistics Ltd., Waterloo,Ontario
9	Red Clover, Cover Crop Studies.	Conservation Management Systems, Lucan, Ontario
10	Effects of Tillage Practices on the Quality and Quantity.	University Of Guelph, Guelph, Ontario
11	Management of Farm Field Variability I. Quantification of soil loss in Ontario Complex Topography; II. Soil Erosion Processes on Shoulder slope Landscape Position	University of Guelph, Guelph, Ontario

12	The use of Cover Crops for Nutrient Conservation.	University of Guelph, Guelph, Ontario
13	Management of Farm Field Variability III. Effect of Tillage System, and Phosphorus Loss.	University of Guelph, Guelph, Ontario
14	The Feasibility of Band Spray Application in Conjunction with Interrow Cultivation in No-till Corn.	Southwestern Ontario Agricultural Research Corporation, Harrow, Ontario
15	Land Reshaping of Lowland Clay Soils. I. Field Study.	Can-Ag Enterprises, Guelph , Ontario
16	Land Reshaping of Lowland Clay Soils, II. Modelling Report.	Can-Ag Enterprises, Guelph , Ontario
17	Evaluation of O.B.A.T.A Approach to Low Input Farming.	Can-Ag Enterprises, Guelph , Ontario
18	Loss of Nitrogen by Microbial Denitrification, Nitrification, Surface and Tile Runoff: Relation to Tillage Methods.	University of Windsor, Windsor, Ontario
19	Phosphorus Movement in Soil as a Function of Phosphorus Solubility and Reactivity.	University of Guelph, Guelph, Ontario
20	Rainfall Simulation to Evaluate Erosion Control.	Ecological Services for Planning, Guelph, Ontario
21	Soil Loss by tillage erosion: The Effects of tillage Implement, Slope Gradient, and Tillage Direction on Soil translocation by Tillage.	University of Guelph, Guelph, Ontario
22	Manure Management in Conservation Farming.	REAP-Canada, Macdonald College, P.Q.
23	The Effect of Conservation tillage Practice on the losses of Phosphorus and Herbicides in Surface and Sub- Surface Drainage Waters.	Southwestern Ontario Agricultural Research Corporation, Harrow, Ontario

AGRICULTURE CANADA GREAT LAKES WATER QUALITY RESEARCH PROJECTS

Title of Research Project	Investigator Names(s) & Organisation
Review of research on ground water contamination from non point source in the great lakes - completed	J. Millette,Centre for Land and Biological Resources Research (CLBRR), CDA, Ottawa

Development of criteria to determine which pesticide classes pose a threat to the Great Lakes environment. (completed)	A. S Hamill, CDA, Harrow
Reduced chemical-input systems for field crops to improve water quality.	J. Culley, CLBRR, CDA, Ottawa
Application of transport model & to determine migration rates of agriculture chemicals through soils of the Great Lakes basin.	R. DeJong, CLBRR, COA, Ottawa
Estimation of atmospheric transfer of agrochemicals affecting the Great Lakes Water quality.	R.Desjardins. CLBRR, CDA, Ottawa
Physical chemistry parameters controlling pesticides persistence and leaching in watershed soils.	D. S. Gamble, CLBRR. CDA, Ottawa
Effect of livestock manure application and management on surface water quality.	G.Grarit, Upper Thames River Conservation Authority
Kinetics and pathways of microbial pesticide degradation.	E. Topp, CLBRR. CDA, Ottawa.
Occurrence and fate of selected agricultural pesticides in sediments of the Great Lakes.	R. Coote, CLBRR, CDA, Ottawa
Fate and modelling of agricultural chemicals In soil, groundwater, and agricultural drainage water under farm conditions. (3 years data available)	N. K. Patni, ARC, CDA, Ottawa
Identities and distribution of arthropods In seeps, springs, first and second order streams and biomonitoring of agricultural activity.	D. R. Oliver, Biological Research Centre, CDA, Ottawa
Integrated soil, crop and water management system to abate pesticide and nitrate contamination of the Great Lakes. (4 years data available)	C. S. Tan et al, Research Station, Harrow
Transport and Dissipation pathways of pesticides in watersheds under conventional and conservation tillage. (2 years data)	B.T. Bowman, London Research Centre, & Greg Wall, LRRC, Guelph
Application of WEPP to Canadian conditions.	Greg Wall, LRRC, Guelph
Irrigation; Trickle and Sprinkler; Completed	C. S. Tan, Research Station, Harrow

PROJECTS FUNDED BY ONTARIO MINISTRY OF ENVIRONMENT

Agricultural Impact on Rural Waterways

Project Title	Investigator Names(s) & Organisation
The effect of agricultural drainage on sediment and water quality loading	E. Watt, Dept. of Civil Engineering Queen's University, Kingston, Ont.
In situ determination of fecal indicator bacteria survival in agricultural watershed	M. Walters, Lake Simcoe Region Conservation Authority, New Market Ontario
Tillage and event based soil and phosphorus loss	R. Kachanoski, W. T. Dickinson, R. Rudra, University of Guelph, Guelph, Ont.
Assessment of fecal pollution transport in agricultural impacted watersheds using a biotracer	M. Walters, Lake Simcoe Region Conservation Authority, New Market Ontario
The relative effect of individual environmental factors on indicator bacterial survival	E. Harris, Lake Simcoe Region Conservation Authority, New Market, Ontario
Development of relative treatment systems for milkhouse wash water	P. Groenevelt, University of Guelph
Flow of manure through soil macropores	R. Fleming, Agr. Eng. Ser. CCAT, Huron Park, Ontario
The impact of farm liquid waste application on receiving water	D. Dean, Ausable-bayfield Conservation Authority Exeter, Ontario
To develop a reliable, economical and environmentally safe method of milkhouse effluent disposal using pretreatment and/or modified leaching bed method	C. Weil, ACAFT, Alfred, Ontario
Movement of agricultural and domestic waste water bacteria through soils	H Lee, et al., University of Guelph, Guelph, Ontario
A study of the suspended fluvial sediments with enteric bacteria in agricultural drains	D. Hayman, Upper Thames Conservation Authority London, Ontario
Evaluation of Steptococcus faeclum subep, Toronto, casselifiavus model to assess pollution sources at the Kelso Conservation Area	P. Seyfried, University of Toronto,Ontario
Comparison of liquid manure spreading practices on the tile drained water quality	M. Foran, Ausable-bayfield Conservation Authority Exeter, Ontario

Spatial and temporal analysis of the occurrence of herbicide residue in a major Southern Ontario agricultural watershed	R. Walker, Beak Consultant Ltd.,Guelph, Ontario
An integrated NPS model for watershed Planning	R. Rudra & T. Dickinson, University of Guelph, Guelph, Ontario
Economic pay-off of sediment reduction from changes in agricultural production practices	P. Stonehouse & W. Van Vuuren, University of Guelph, Guelph, Ontario
Effect of sediment nutrient levels on fecal bacteria indicator at a beach and a agricultural drain in Southwestern Ontario	K. Poel, Upper Thames River Conservation Authority London, Ontario
Identification of fecal coliform and fecal steptococcus and verification of newer tests	P. Seyfried, University of Toronto, Toronto Ontario
The effect of tile drainage and open ditches on peak flows and dry weather flows	E. Watt, Queen's University, Kingston, Ontario
Sediment transport model search and implementation	M. Holloran, Gore and Storrie Ltd.
Assessment of the current waste management practices on farm operation in Perth County, Ontario	M. Haight, University of Waterloo, Waterloo, Ontario
The effect of agricultural waste management practices on receiving water quality with respect to bacteria, phosphorus, nitrogen and sediment loads	D. Balint, Ausable-bayfield Conservation Authority Exeter, Ontario
Humber River/Black Creek: Detailed Bacteriological water quality study examining the impact of sediment and survival times	P. Seyfried, University of Toronto, Toronto, Ontario
Practical application of fecal coliform (FC) to streptococcus faeclum subsp.casselifivaus (SC) and bifidobacterium to SC ratio to determine human and animal sources of pollution.	P. Seyfried, University of Toronto, Toronto, Ontario

Groundwater Contamination

Development of a hydrological model to predict the environmental fate of De-icing Salts	Ken Howard, University of Toronto, Toronto, Ontario
The origin and distribution of in the Alliston Aquifer	James Baker, University of Waterloo, Waterloo, Ontario

Measuring Groundwater Velocity and Hydrodynamic Dispersion in a single Fracture in Fractured Shale	John Cherry, University of Waterloo, Waterloo, Ontario
In situ Biodegradation of chlorinated Solvents as a Remedial Technology for Ontario Contaminated Groundwater	David Major, Beak Consultants Limited, Guelph,
Groundwater impact from Large Septic Systems for Sewage Disposal in Ontario	John Cherry, University of Waterloo, Waterloo, Ontario
Bias Due to Sampling Groundwater and Surface Water for the Trace Organic Contaminants	James Baker, University of Waterloo, Waterloo, Ontario
Determination of Hydrological and Contamination Transport Properties of Ontario Fractured, Weathered Leda Clay in Eastern Ontario	Norm Castonquay, Frondex Limited, Nepean
Impact of Livestock Manure and Fertilizer Application on Nitrate Contamination of Groundwater	Reginald G. Kachanoski, University of Guelph, Ontario
The Use of Environmental Isotope Surveys in Assessing Contamination Potential for "Confined" Aquifers	Michael Sklash, University of Windsor, Windsor, Ontario
Determination of Geochemical Modification of Groundwater Entering Surface Waters from an Industrial and Municipal Disposal Sites	David Lee, Chalk River Nuclear Laboratories, Chalk River, Ontario
Reduction of Nitrogen Loss from Animal Manures by Stabilization with Ammonium Adsorbing Minerals	Paul Voroney, University of Guelph, Guelph, Ontario
Enhanced *in situ* Bioremediation of Groundwater Contaminated with Solvents Using a Permeable Nutrient Delivery Wall	James Baker, University of Waterloo, Waterloo, Ontario
Susceptibility of Groundwater Contamination: A Case Study with Policy- Implications	Marie Sanderson, University of Waterloo, Waterloo, Ontario
Hydrology of the Oak Ridges Moraine	Ken Howard, University of Toronto, Toronto, Ontario
Nitrate Persistence in Slightly Permeable Sediments in Ontario	Robert Gillham, University of Waterloo, Waterloo, Ontario
Groundwater Recharge and Contamination: Sensitivity Analysis for Carbonate Aquifers in Eastern Ontario	Ian Clarke, University of Ottawa, Ottawa, Ontario

An investigation of the Environmental Health Hazards Associated with Road Oiling.	Guillaume, L.S. Love and Associates Canada Ltd.
Investigation of Nitrate Distribution and Nitrogen Transformations in Shallow, Sandy Aquifer near Alliston, Ontario	R. Gillham, University of Waterloo, Waterloo, Ontario
Assessing the Impact of Hazardous Liquids Spilled onto the Soil.	G. Farquhar, University of Waterloo, Waterloo, Ontario
Road Dust Suppressant Study.	R. Gillham, University of Waterloo, Waterloo, Ontario
Investigation of the Distribution, Origins and Behaviour of Local Shallow Ground-waters Containing Elevated Concentrations	K. Howard, University of Toronto, Toronto, Ontario
Development and Validation of protocols for Sampling Surface and Groundwaters for Volatile Organic Contaminants of Chloride.	J. Baker, University of Waterloo, Waterloo, Ontario
Groundwater/Phosphorus Leaching Studies	R.L. Thomas, University of Guelph, Guelph, Ontario
Evaluation of Contaminant Velocity Groundwater and Low Permeability Fractured Shale	J. Cherry, University of Waterloo, Waterloo, Ontario
Township of Ignace Groundwater Quality Identification.	D. Tumball, Internation Water Supply Ltd.
Method for the Removal of Organic Compounds from Groundwater.	D. Smith, Water and Art Associates Ltd.
The Mobility and Persistence of Selected Organic Solutes in Anaerobic Groundwater and Possible *in situ* remediation.	J. Barker, University of Waterloo, Waterloo, Ontario
The Carbon and Surfer cycle in shallow Unconfined Systems.	R. Gillham, University of Waterloo, Waterloo, Ontario
A Study of Geochemical Modification of Groundwater Discharging into Surface Waters From an Industrial Disposal Site.	D.Lee, University of Waterloo, Waterloo, Ontario

Environmental Protection Publications
Conservation and Protection
Environment Canada
Ottawa Ontario KIA OH3

Agriculture -- Reports

1 Implications of reduced and no-tillage systems on chemical use in the Prairie Provinces, by A.A. Acluatic Research Limited, for the Western and Northern Region, Environment Canada, Ottawa, 1985, 20p.
2. Phosphate fertilizer and sewage sludge use on agricultural land - the potential for cadmium uptake by crops, by M.D. Webber, Wastewater Technology Centre, Water Pollution Control Directorate, Ottawa, 1979, 32p.
3. Air-dried chemical sewage sludge disposal on agricultural land - Volume I, by D.N. Bryant and D.B. Cohen, Wastewater Technology Centre, Water Pollution Control Directorate, Ottawa, 1978, 45p.
4. State-of-the-art review of processes for treatment and reuse of potato wastes, by J.P. Stephenson and P.M.H. Guo, Wastewater Technology Centre, Water Pollution Control Directorate, Ottawa, 1977, 84p.
5. Drying potato wastes for animal feed as an alternative disposal method, by Canadian Bio Resources Ltd. , for the Water Pollution Control Directorate, Ottawa, 1977, 85p.
6. Agricultural and food processing waste treatment and disposal, 69p.
7. Inventory of spray irrigation systems in the Great Lakes Basin of Canada, prepared by Reid, Crowthers and Partners Ltd., for the Water Pollution Control Directorate, Ottawa, 1973, 15p.
S. Toxicity of landfill leachates, Department of civil Engineering, university of British Columbia, 36p.
9. Industrial waste characterization in the Ontario Pesticide Industry, 27p.
10. Pesticides - Research and monitoring annual report 1987-88, commercial chemicals Branch, Environment Canada, Ottawa, 1989, 84p.
11. PCBs and PCTS in commercially available products and in samples of garbage, 22p-
12. Environmental monitoring of federal and provincial projects, proceedin4s of a meeting held in Ottawa, January 26, 1982, 124p.
13. Guidelines for effluent quality and wastewater treatment at federal establishments, 17p.
14. Anaerobic treatment of dairy effluent, by BEAK Engineering Limited, under contract to AGROPUR Cooperative AgroAlimentaire, for the Technology Development and Technical Services Branch, Environment Canada, Ottawa, 1986, 165p.
15. Performance evaluation of an oxidation ditch treating dairy wastewater, by P.H.M. Guo, P.J.A. Fowlie, V.W. Cairns and B.E. Jank, Wastewater Technology Centre, Water Pollution Control Directorate, Ottawa, 1979, 32p.

ADDITIONAL RESEARCH BY INDIVIDUAL CURB PROGRAM AREA

In addition to large and small scale surface water quality monitoring, current research and experimental activities are summarized by Conservation Authority:

Ausable Bayfield

1. Lakeshore subdivision surface and subsurface drainage projects to enhance operation of existing class IV septic systems in heavy clay soils with high water tables along Lake Huron shoreline subdivisions. Lakewood Gardens South and Highlands II. Hay Township, Huron County, north of Grand Send.
2. Alternate private sewage systems: Waterloo Biofilter, Lucan, Biddulph Township, and Middlesex County,
3. Rapid Detection Study in Grand Bend. Currently evaluating high speed indicator organism analysis in 6-8 hours (as opposed to the standard 30 hours). Potential applications to all public bathing beaches in Ontario (or the world). May decrease the number of days a beach would be posted due to turn around time.

Credit Va1ley

1. Biotracer study on malfunctioning septic systems. Village of Erin, Wellington County.
2. Correlation study with BIOMAP invertebrate monitoring, fisheries inventory, and surface water quality.

Essex Region

1. Artificial constructed wetland, for barnyard runoff and milkhouse washwater treatment.
2. Malden Valley Farms, Maidstone Township, Essex County.
3. Alternate private sewage system with organic media beds.

Grand River

1. Stream benthic assessment on impaired and rehabilitated watercourses (1994).
2. Nutrient management study (I 994).

Nottawasaga Valley

1. Artificial constructed wetland, for treatment of barnyard and manure runoff, and milkhouse washwater, Grumble Hill Farm, Essa Township, Simcoe County,
2. Collingwood/Wasaga Beach Sanitary Survey
3. Batteaux River benthic and aquatic habitat assessment.

Otonabee Region

1. Alternate private sewage system, huge Waterloo Biofilter system, for multiple units at Southview Cottages, S. Monaghan Township, Peterborough County.
2. Benthic community and surface water quality study-

Prince Edward Region

1. Artificial constructed wetland, for treating barnyard runoff, Oskar Schnaithmann, Sydney Township, Hastings County.
2. Milkhouse Washwater flocculator system, Jacob Earl and Anna Vandermullen, Thurlow Township, Hastings County.
3. Bioengineering livestock access restriction study.

Raisin Region

1. Milkhouse Washwater flocculator system, Donald Thompson, Glen Springs Farm, Charlottenburgh Township, Glengarry County.

Rideau Valley

1. Solar powered watering facilities for livestock, partnership with the UTRCA and LSRCA, 1995-97.
2. Bentonite lined earthen manure storage, evaluating long term feasibility.
3. Artificial constructed wetland, for barnyard runoff treatment, Jim Peaker Farm, Rideau Township, Regional Municipality of Ottawa Carleton.
4. Milkhouse washwater precipitation (flocculator) system, John Hill Farm, City

Grey Sauble

1. High powered electric fence system.

Lake Simcoe Region

1. Solar powered livestock watering project study 1995-97.

Maitland Valley

1. Milkhouse washwater tank and treatment trench study to investigate the effects of septic tank treatment on faecal indicator organisms and nutrients. Dutch Dream Farms, Elma Township, Perth County.

Metropolitan Toronto and Region

1. Vegetated Filter Strip, for barnyard runoff treatment, Livingston farm, Region of Peel.
2. Artificial Constructed Wetland, for barnyard, manure storage runoff, and milkhouse washwater treatment, Ted Dean farm, Town of Caledon.
3. Livestock access restriction water quality studies.
4. Nutrient management study (1994).

Mississippi Valley

1. Milkhouse Washwater treatment in a grease trap and modified filter bed system, Harold McPhail Farm, Ramsey Township, Lanark County.

Niagara Peninsula

1. Artificial Constructed Wetland, for barnyard, manure storage runoff, and milkhouse washwater treatment, Bill Mitchell farm, Glenbrook Township, Niagara Region.
2. Artificial Constructed Wetland, for barnyard runoff treatment, Norm Johnson farm, West Lincoln Township, Niagara Region.
3. Alternate private sewage system with recycling grey water system of Nepean, Regional Municipality of Ottawa Carleton.
5. Nutrient management study.
6. Chemical precipitation (flocculator) of phosphorus in septic system, multiple cottages and residences on Upper Rideau Lake, North Crosby Township, Leeds & Grenville County.

South Nation River

1. Artificial constructed wetland, for treating barnyard and manure storage runoff, and milkhouse wastes, Michael and Hector Dignard Farms, Russell Township, Prescott and Russell County.
2. Milkhouse Washwater flocculator system, Rejean Pommainville farm, Cambridge Township, Prescott and Russell County.

St. Clair Region

1. Alternate private sewage system with peat filter bed, Coldstream, Lobo Township, Middlesex County.

Upper Thames River

1. Artificial Constructed Wetland for barnyard runoff, Bill French Farm, Fullarton Township, Perth County.
2. Solar Powered Livestock Watering Project Study 1995-97.
3. Alternate Private Sewage System with Organic Media and Sand Filter Beds, UTRCA Office, London.
4. Alternate Private Sewage System with Sand Filter Beds, residence, Thorndale, West Nissouri, Middlesex County.
5. Earthen Lagoon Decommissioning, Van Boekel Farm, Blanford Blenheim Township, Oxford County.
6. Earthen Lagoon Long Term Groundwater Monitoring, Rudy Rauser Farm, Fullerton Township, Perth County.
7. Milkhouse Washwater Tank and Treatment Trench Long Term Operations.

APPENDIX V

Minutes of 1999 OWMRSC Annual Meeting, September 28, 1999

Members Present: Chin Tan (AAFC, Harrow)
Dan Reynolds (AAC, Harrow)
Janice LeBoeuf (ERCA, Essex)
Pieter Groenevelt (U of G, LRS)
Jim Myslik (OMAFRA, Fergus)
Lloyd Logan (Environment & Hydrology Corp., Markham)
Ramesh Rudra (U of G, Engineering)
Paul Fish (GRCA, Cambridge)

Members Absent: Frank Letouneau (OFA., Chatham)
Tom Sawyer (FIO, Cambridge) (retired)
John O'Sullivan (OMAFRA, Simcoe)
Ross Irwin (Farm Drainage Coalition, Guelph)
Howard Ng (CCIW, Burlington)
N.K. Kaushik (U of G, Environmental Biology)

Guest: Gary Parkin (U of G, LRS)

Meeting Convened: Time: 10:16 a.m.
Location: Room 334, University Centre, University of Guelph, Guelph

Items Considered in Chronologic Order:

1. **Agenda approved as presented.**
   Moved: Rudra; Seconded: Groenevelt

2. **Minutes of last meeting (September 8, 1998) accepted as presented.**
   Moved: Myslik; Seconded: Rudra

3. **Inventory of Ongoing Research and New Research Recommendations**

   Agreed that the inventory would be updated and included in this year's OWMRSC annual report.
   As not all projects in the inventory are supported due to lack of funds, it was agreed that Rudra would collect together all supported (funded) projects and link them to the OWMRSC research recommendations.

   Any new research initiatives or research recommendations that the committee are aware of are to be submitted to Rudra by the end of October, 1999. If no new research

recommendations are forwarded by the committee, this year's report will simply refer to the recommendations in the 1998 OWMRSC report.

Action: Rudra to link all funded research projects to OWMRSC research recommendations for incorporation into the 1999 report by Tan.

4. Feedback from Upper Committees

Agreed that lower level committees such as this one are not getting enough feedback from the upper level committees regarding how the upper committees treat research recommendations.

Agreed to recommend to upper committees that the lower committees be given regular feedback on how to organize and present research recommendations. Provincial funding is allocated on the basis of issues developed by the upper committees. Lower committee recommendations should therefore be designed to fit into one or more of the established issues. The current water management issues seem to be related to water sharing/ quality/ partitioning, and wetland/riparian zone management. These issues should be explained in detail so that the lower committees understand what is meant (Rudra).

Action: Rudra to ask Chairs of the relevant upper level committees for clarifications of their issues.

5. **Emerging Water Management Issues**

Agreed that this committee should have a "think tank" function that focuses on predicting future issues and trends in water use and management. To this end, the committee attempted to define current and probable future issues and trends in water use and management. These are listed below.

- **Soil Conservation Practices:** In some regions, farmers are starting to "backslide" on soil conservation practices because soil quality has been recovered, erosion has been largely stopped, and conservation practices and equipment are expensive to maintain. At this point, the backsliding is mainly in the form of abandoning no-tillage in favour of conventional tillage (e.g. mouldboard plowing, discing, chisel plowing), and neglecting maintenance of erosion control structures. Agreed that province needs to mount programs to convince farmers of the long-term economic and environmental advantages of maintaining soil conservation practices. (Groenevelt)

- **Soil Quality/Nutrient Management:** Focus shifting toward large production systems (perhaps even multi-farm and multi-owner) which incorporate crop rotations and livestock as a means for maintaining soil quality, disposing of organic wastes, and maintaining soil fertility. If done correctly, these systems will also protect water quality, especially with respect to phosphorus and nitrogen. Research needs to be mounted in this area to develop best management practices for these types of systems. Phosphorus loss is still an issue. Research is needed to establish the nature and dynamics of phosphorus in the soil profile, as well as how phosphorus should be measured and accounted for in a soil test (Myslik). Land farming of biosolids is generating increasing public concern over

possible introduction of pathogens, pharmaceuticals, hormones, etc. into the food chain. Research should be increased on developing better methods for land farming of biosolids. Monitoring of soil and water impacts should be continued (Fish).

- **Soil Compaction:** Rising interest among farmers in prevention and management of soil compaction. Farmers in some areas are starting to see crop production problems which they attribute to soil compaction. Research may be needed to determine: (1) if compaction is in fact the problem; (2) development of compaction prevention strategies that are economic (Fish).

- **Water Management and Sharing:** It is now well established that ground water tables are declining, reservoirs are below optimal capacity or completely dry, and flows in major water courses are below optimal. At present, we do not know the capacities of our aquifers, when an aquifer is being overused (before it collapses), how fast an aquifer can recover, and how fast aquifer recharge areas actually recharge the ground water. Also, the impact of tile drainage on ground water levels and quality is still largely unknown. Farm and regional scale research is needed to determine how water is partitioned among surface runoff, tile drainage and ground water recharge for specific soils, climates and land use systems (e.g. cash crop farming, irrigated agriculture, urban, etc.). Water management schemes need to be customized to fit specific soil and landscape types as well as specific land use (e.g. farming) systems. The Ontario government will soon publish a provincial water management plan which will have major impacts on water sharing and use.

- **Provincial Soil Resource Protection Programs:** A new generation of programs is coming which are targeted to specific problem areas in Ontario. Farmers are now willing to accept site-specific programs directed at localized hotspot areas. Previously, they would accept only large, generalized, province-wide programs (e.g. SWEEP, Green Plan, etc.). These new programs will require Researchers to partner with local groups (e.g. farmers, towns, municipalities, etc.) in the hotspot areas, which may be difficult because of conflicting/incompatible agendas among the partners. The current trend in research program delivery is to bring several groups together (e.g. government research, universities, conservation authorities) who will contribute varying amounts of labour, money and expertise (Myslik, Fish).

6. Summary of Emerging Water Management Issues and Research Recommendations

It was agreed that the main current and emerging **water management issues** were:

- Water Quality
  - nutrient levels (N, P, K)
  - pathogens and bacteria
  - pesticide residues
  - sediment
    - water clarity
    - sedimentation of water courses
- Water Quantity
  - rectifying spring/fall excesses with summer deficits
  - irrigation
  - sewage flows

- aquifer maintenance and sustainable use
- hydrologic partitioning among
    - tile flow
    - runoff
    - ground water recharge
    - evapotranspiration
    - stream flow
- ground and surface water withdrawals by
    - agriculture
    - industry
    - municipalities

It was agreed that the main water management **research recommendations** should include:

- Development of hydrologic budgets to determine the partitioning of water among surface runoff, stream flow, tile flow, ground water recharge, soil water (unsaturated zone) storage, and evapotranspiration.

- Development of procedures for measuring and accounting for phosphorus in soil, tile drainage, stream flow and ground waters.

- Initiation of aquifer studies focussed on:
    - determining aquifer water storage capacity.
    - developing "early-warning" indicators of aquifer over-use to prevent aquifer collapse and permanent damage or impairment.
    - developing methods for determining rates of aquifer recharge/depletion/recovery under different usage and climate scenarios.
    - developing strategies for sustainable aquifer use on a site-specific basis.

It was further agreed that the above main issues and recommendations will have to be "filled out" over time so they are better understood.

Action: Committee members are to "flesh out" the above issues and note any new issues. New issues are to be sent to Rudra.

7. New Business

- New Membership:

- Agreed that Dr. Gary Parkin, LRS, U of G, will replace Dr. Piet Groenevelt who is retiring from this committee. **Action: Groenevelt to transfer his OWMRSC info to Parkin.**

-Agreed that Mr. Paul Fish will find a replacement for himself on this committee, as he is retiring from both GRCA and this committee next year. **Action: Fish to find suitable GRCA replacement.**

-New Chair:

- Dr. Chin Tan has completed his 2-year term as Chair. Jim Myslik agrees to assume the Chair providing that he can be released from duties on certain other provincial committees. He will give a definite answer by December, 1999. Tan to continue with Chair duties on interim basis and finish off this reporting year. **Action: Myslik to notify Tan by December 30, 1999.**

- Committee Participation:

- Tan noted that membership of this committee is fairly high, but attendance of meetings is low. Probable cause is the relatively large time investment in travelling to the meeting site at U of G. Agreed that Tan will explore possibility of increasing participation by conducting meetings by conference call to reduce the necessity for travel. **Action: Tan to canvass membership as to feasibility and acceptability of conducting meetings by conference call.**

-Water Management Workshop:

- Agreed that the OWMRSC should host a 1-2 day workshop late in the year 2001 at the OMAFRA building on Stone Road, Guelph. Rudra will chair the workshop organizing committee; committee membership will be determined later. Rudra will draft a 1-page call for papers for review and revision by the committee. The format and content of the workshop is yet to be established, but will probably have an invited keynote speaker for each section and a panel discussion at the end of each session. Possible topics include (but are not limited to): measurement and management of water excesses, deficits, storage and recharge; management of biosolids and composts; management of phosphorus. **Action: Rudra**

8. **Next Meeting:** At the call of the Chair, probably in late August or early September, 2000.

9. Meeting adjourned 14:00.

APPENDIX II

OSWARSC Committee Memberships

Ontario Soil, Water and Air Research and Services Committee.....II-2
- Ontario Agrometerology Research and Services Committee.....II-4
- Ontario Soil Management Research and Services Committee.....II-5
  - Field Crops Committee.....II-7
  - Horticultural Crops Committee.....II-8
  - Soil and Water Quality Committee.....II-9
  - Soil Test Lab Committee.....II-9
  - Tobacco Committee.....II-10
  - Waste Utilization Committee.....II-10
- Ontario Water Management Research and Services Committee.....II-11

Ontario Soil, Water and Air Research and Services Committee - 1999

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Sub-Committees
of the
Ontario Soil Management Research and Services Committee

1. Field Crops Subcommittee

1999 meeting: March 3 at OMAFRA Building, 1 Stone Road Guelph
2000 meeting: February 29 at OMAFRA Building, 1 Stone Road Guelph

1999 Membership	Organization	Attendance
Doug Young (CHAIR)	RCAT, U. of Guelph, Ridgetown	Y
Tom Bruulsema (SEC.)	PPI, Guelph	Y
Bill Allison	AgCARE, Toronto	N
Bill Curnoe	KCAT, U. of Guelph, Kemptville	N
Craig Drury	AAFC Harrow	N
Graham Gambles	OSCIA, Haileybury	Y
Leo Guilbeault	OSCIA (Alternate), Belle River	N
Peter Johnson	OMAFRA Komoka	Y
Don Lewis	Ontario Canola Growers Assoc., Holstein	N
Patrick Lynch	TFIO, Shakespeare	Y
Liam McCreery	Ontario Soybean Growers, Woodstock	N
Chris Meier	Ontario Forage Council, Belgrave	N
Ivan O'Halloran	RCAT, U. of Guelph, Ridgetown	Y
Dale Peters	DAP Consulting, Rodney	Y
Keith Reid	OMAFRA, Walkerton	Y
Rob Templeman	OMAFRA Stratford	Y
Bill Wagter	OCPA, Dunnville	N

2. Horticulture Crops Subcommittee

1999 meeting: March 31 in Woodstock
2000 meeting: in March (exact date and location to be set)

1999 Membership	Organization	Present in 1999	
Maribeth Fitts (Chair)	OMAFRA, Vineland Station	Y	
Chris Kessel (Chair in 2000)	OMAFRA, Dept. of Hort. Science, U. of Guelph	Y	
Annette Anderson	OMAFRA, 1 Stone Road, Guelph	?	
Jody Bodnar	OMAFRA, Simcoe	?	
Theo Blom	H.R.I.O., Vineland Station	?	
Wayne Brown	OMAFRA, Vineland Station	?	
Pam Charbonneau	OMAFRA, GTI, U. of Guelph	Y	
Calvin Chong	H.R.I.O., Vineland Station	Y	
Ken Collins	1402 Hwy. 5 West, R.R. #1, Troy	?	
Rosemary Davis	Tri-County Agromart Ltd.,Trenton	?	
Maria Derkacz	H.R.I.O., Vineland Station	?	
Jim Dick	Nabisco Brands Ltd., Dresden	?	
John Gardner	OMAFRA, Komoka	?	
Henry Klassen	Stoney Point Co-op, Stoney Point	?	
Mary-Ruth McDonald	OMAFRA, Muck Research Station, Kettleby		Y
A.W. McKeown	OMAFRA, Hort. Experiment Station, Simcoe		Y
Ivan O'Halloran	RCAT, University of Guelph, Ridgetown	Y	
John O'Sullivan	OMAFRA, Hort. Experiment Station, Simcoe		Y
John Potter	Agriculture & Agri-Food Canada, Vineland Station	?	
Tom Sawyer	Fertilizer Institute of Ont., Cambridge		N
John VanderBurgt	R.R. #1, Dashwood	Y	
Anne Verhallen	OMAFRA, College of Ag. Tech., Ridgetown	Y	
Claudia Wagner-Riddle	Land Resource Science, University of Guelph	N	
Doug Young	RCAT, University of Guelph, Ridgetown	Y	

3. Soil and Water Quality Subcommittee

1999 Meeting?
2000 Meeting February 8, 2000 at OMAFRA in Guelph

1999 Membership	Organization
Pat Feryn (Chair)	Cargill
Doug Aspinall	OMAFRA, Guelph
Dale Cowan	Agri-Food Labs, Guelph
Ed Gregorich,	AAFC, Ottawa
Mike Goss	Dept. LRS, U of G, Guelph
Adam Hayes	OMAFRA, Ridgetown
Keith Matthie	OSCIA
Keith Reid	OMAFRA, Walkerton
Dan Reynolds	AAFC, Harrow
Tom Sawyer	TFIO
Ed Topp	AAFC, London
Paul Voroney	Dept. LRS, U of G, Guelph
Doug Young	RCAT, U of G, Ridgetown

Membership list is from report presented to OSMRSC at the June 15-16, 1999 meeting

4. Soil Test Lab Subcommittee

1999 Meeting	December 10,1999 in Guelph
2000 Meeting	December in Guelph

1999 Membership	Organization	Attendance	
Peter Haulena (Chair)	Accutest Labs, Nepean	Y	
Papken Bederian	Agrifood Labs, Guelph		Y
Jim Brimner	Stratford Agri Analysis		Y
Dale Cowan	Agrifood Labs, Guelph		N
Rob Deakins	A&L Labs Canada, London	Y	
Graig Drury	AAFC, Harrow	N	
Susan Fitzgerald	TFIO, Guelph	N	
Virginia Kerslake	Analytical Services, University of Guelph	Y	
Christoph Kessel	OMAFRA, Guelph	Y	
Ian McLachlin	A&L Labs Canada, London	Y	
Ivan O'Halloran	RCAT, U of G, Ridgetown	Y	
Keith Reid	OMAFRA, Walkerton	Y	
Elaine Roddy	OMAFRA, Brighton	Y	
Tom Sawyer	Sylvite	N	

5. Tobacco Subcommittee

1999 Meeting ?
2000 Meeting ?

1999 Membership	Organization
Marcel Anseeuw (Chair)	Ontario Flue-Cured Tobacco Growers' Marketing Board
Dan Van Hooren (Sec.)	OMAFRA, Delhi
Dr. Bonnie Ball-Coelho	AAFC, Delhi
Dr. Ron Beyaert	AAFC, Delhi
Randy Corneillie	RJR-Macdonald Inc., Tillsonburg
Gerard Demaiter	Ont. Flue-Cured Tobacco Growers' Marketing Board, Langton
Morris Eccles	TFIO Norwich Fert. Inc., Norwich
Don Fooks	TFIO, Delhi
Lori Long	Rothmans, Benson & Hedges Inc., Tillsonburg
Brent Manary	Ontario Flue-Cured Tobacco Growers' Marketing Board, Vienna
Al Ratavicius	Imperial Leaf Tobacco, Aylmer
Keith Reid	OMAFRA, Walkerton
Allyson Veinot	OMAFRA, Delhi

6. Waste Utilization Subcommittee

1999 Meeting Terra Tech?
2000 Meeting March 9, at Husky Farm Equipment, Alma

1999 Membership	Organization	Attendance	
Chris Brown (CHAIR)	OMAFRA, Woodstock		Y
Don Hilborn	OMAFRA, Woodstock		Y
Murray Blackie	MOE, London		Y
Bruce Bowman	AAFC, London		Y
Jennifer Chateauvert	Cargill	Y	
Ron Fleming	RCAT, U of G	Y	
Graham Gambles	OSCIA	Y	
Michael Goss	Dept. LRS, U of G	Y	
Raymond Grose	Husky Farm Equipment	Y	
Mark Janiec	Terra Tech	Y	
Peter Stonehouse	U of G	Y	

new member to be added for 2000 (not yet confirmed) representing biosolids / paper sludge .

ONTARIO WATER MANAGEMENT RESEARCH & SERVICE COMMITTEE

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APPENDIX III

Main and Sub-Committees Terms of Reference

Ontario Soil, Water and Air Research and Services Committee (OSWARSC)

The Ontario Soil, Water and Air Research and Services Committee (OSWARSC), formed in 1971, has three subcommittees, namely, the Ontario Agrometeorology Research and Services Committee, the Ontario Soil Management Research and Services Committee, and the Ontario Water Management Research and Services Committee.

Duties and Terms of Reference

1. To identify soil, water and air research required in relation to present and future needs and opportunities for development of the agricultural industry in Ontario.

2. To access and make recommendations on the priorities to be applied to these matters.

3. To facilitate means of meeting such needs efficiently with the resource available from time to time by:
   a) considering and approving chairmen and membership of subcommittees;

   b) evaluating cost-benefits of research;

   c) examining the suitability of institutions or persons to assume responsibility for various research programs;

   d) projecting resources needed for research;

   e) describing how resources may be obtained or freed for new program requirements.

   (f) reviewing operations of subcommittees through reports submitted;

   (g) reporting to OASCC on such matters as required; and

   (h) promoting greater interaction between scientists in soil management, water management, agrometeorology, and soil survey and land use, and between scientists and extension personnel.

Terms of Reference

Ontario Agrometeorology Research and Services Committee (OARSC)

3. To identify the requirements for research and service in the agrometeorology area in relation to present and future needs of the agricultural industry of Ontario.

4. To assess and make recommendations on the research priorities.

5. To facilitate ways and means of meeting the research and service needs in the agrometeorology area by:

   a) bringing together from time to time various research, extension, and scientific services personnel to consider particular problem areas;

   b) exchanging information on interests, capabilities, projects, accomplishments, and available resources of research and service workers in the agrometeorology area;

   c) evaluating costs and benefits of the research and service requirements;

   d) proposing new directions of research and service;

   e) projecting resources needed to accomplish research and service objectives;

   f) reporting to OSWARSC on these matters.

Terms of Reference

Ontario Soil Management Research and Services Committee (OSMRSC)

1. To assist in bringing together farmer user, industry, research, extension and regulatory personnel to discuss soil management problems in Ontario.

2. To formulate recommendations concerning fertilizer use and other soil management practices.

3. To forward recommendation to the Manager, Nutrient Programs, Resources and Regulations Branch, to be implemented in the OMAFRA Accredited Soil Test.

4. To provide a forum for the exchange of research information and coordination of research effort on soil management problems in Ontario.

5. To define research requirements in relation to present and future needs and opportunities for development of the agricultural industry.

6. To make recommendations to the Ontario Soil, Water and Air Research and Services Committee concerning the requirements and priorities for research and services.

7. To suggest ways of meeting the research and service requirements by:
   (a) evaluating research and service cost-benefits;

   (b) recommending appropriate institutions to do the work;

   (c) projecting resources needed for the research and services;

   (d) describing how resources may be obtained or freed for the research or services.

Ontario Water Management Research & Service Committee

1. To prepare, update and maintain an inventory of water management research and services relevant to agriculture and its associated environmental concerns.

2. To identify water management, research and services required to enhance agricultural industry and to mitigate associated environmental impacts resulting from agricultural activities.

3. To established priorities for implementation and continuation of research and services and to make specific recommendations of Ontario Soil, Water, Air Research and Services Committee.

4. To report annually to the Ontario Soil, Water, Air Research and Services Committee on Ontario Water Management Research and Services Sub-Committee activities.

5. To ensure that the Ontario Soil, Water, Air Research and services Committee concerns and subsequent recommendations are relayed to agricultural groups and research agencies showing interests in water management.

6. To engage in the transfer of results of research and services of water management to agricultural groups, agencies and the public.

APPENDIX IV
Inventory of Current Research Projects in Ontario
(Arranged by OSWARSC Priority Issue)

Note: There is also a extensive compendium of previous research projects listed in the OWMRSC Committee Report, Pages I-35 - I-56

1. Manure Management

1. Development of a single integrated computer program for the management of manure, biosolids and mineral nutrients. M. Goss, Univ. of Guelph (#24210) 1-year. (creates a single decision support system (DSS) for manure management for use in Ontario.)
2. Risk assessment & economic evaluation of environmental damage associated with livestock manure - dietary strategies & handling alternatives. C. Wagner-Riddle, M. Fan and P. Stonehouse, Univ. of Guelph (#24230) 4-years; (enhance the DSS by adding information on greenhouse gas emissions, and aims to provide estimates of net social welfare impacts of different manure management systems.)
3. Optimizing methods of applying animal wastes and bio-solids on the land at desired rates. B. Hawkins, Univ. of Guelph (#23760) - 4-years (aimed at improving the uniformity of solid manure application from spreaders.)
4. Effect of Feeding Strategy on Energy Expenditure and Amino Acid Catabolism in Visceral Organs. C. de Lange, Univ. of Guelph (#19150) - Animal Program
5. Optimizing Poultry Nutrition and Feed Management in Terms of Production Efficiency and Environmental Management. S. Leeson, Univ. of Guelph (#22590)
6. Amelioration of Odours from Hog Manure by Electrochemical Treatment. N. Bunce, Univ. of Guelph (#22770)
7. Application of Transgenic Methodology in Swine for Reduced Environmental Impact and Enhanced Carcass Quality. ___ Philips, Univ. of Guelph (#23170)
8. Decision support system for manure handling system management. J.Ogilvie - Univ. of Guelph.
9. Energy saving through the use of manure in crop production. N. McLaughlin and G. Wall (external private collaborator) - AAFC Ottawa, 1997
10. Late Fall Application of Manure - C. Weil, Alfred College, Univ. of Guelph (since 1997)
11. Treatment of Manure Pile Runoff and Milkhouse Wastewater - C. Weil, Alfred College, Univ. of Guelph
12. Treatment of Constructed Wetland water to remove phosphorus using Slag - C. Weil, Alfred College, Univ. of Guelph
13. Phosphorus Removal from Septic Wastewater - C. Weil, Alfred College, Univ. of Guelph
14. Persistence of enteric bacteria, antibiotics and hormones in stored manures, and following application to land. E. Topp, AAFC, SCPFRC, London

2. Nutrient Use Efficiency

1) Prediction of available N from soil organic matter and residual legume crop N. B. Kay - Univ. of Guelph; (GPCRC, AAFC, Harrow) C. F. Drury and T.Q. Zhang
2) Evaluation of extraction techniques for estimating potentially available N from manures to crops. M.Goss, L .Evans, Univ. of Guelph.
3) Impact of manure and fertilizer phosphorus applications on phosphorus availability. I.O'Halloran, Univ. of Guelph (#23990) - 2-years (providing information for the DSS related to the leaching of phosphorus (P) compounds that are readily bio-available and can contribute to eutrophication. The project also investigates the availability of manure P to crops relative to inorganic (fertilizer) P.)
4) Fertilization recommendations for cabbage production. I.O'Halloran - Univ. of Guelph.
5) N balance of turfgrass. Univ. of Guelph (C. Wagner-Riddle, G. Thurtell, G. Kachanoski D. Elrick)
6) Processing tomato production: determination of the effect of irrigation and fertigation on yield and fruit solids on a field scale. GPCRC, AAFC, Harrow (A. Liptay, C.F. Drury, C.S. Tan, W.D. Reynolds, T. Jewett).
7) Ginseng N, P & K fertilizer rate trial. R. Beyaert, SCPFRC, AAFC, Delhi.
8) New Test for Improved Prediction of Available Nitrogen (N) . E. Beauchamp, Univ. of Guelph; C. Drury, GPCRC, AAFC, Harrow
9) Nitrogen mineralization of the rye rotation crop as affected by nitrogen regime and the effect on nitrogen fertilizer use in tobacco production. R. Beyaert, SCPFRC, AAFC, Delhi.
10) Nitrogen fertilizer rate trial for forage sorghum and forage millet. R. Beyaert, SCPFRC, AAFC, Delhi.
11) Improvement of fruit production through improvement of soil fertility and fruit tree nutrition. M. Derkacz, Univ. of Guelph
12) Management and measurement techniques for greenhouse nutrient recycling. M. Dixon Univ. of Guelph
13) Dynamics of N Availability and Soil with Various Nitrogen Amendments. E. Gregorich, ECORC, AAFC, Ottawa
14) Improvement of knowledge of i) control of growth of transplants and vegetable crops, and ii) maximizing vegetable yield and quality and iii) composition of vegetable crops. GPCRC, AAFC, Harrow (A. Liptay).
15) Optimizing fertilization and irrigation for container-grown nursery crops. G. Lumis, Univ. of Guelph
16) Identifying Management Units for Site-Specific Nitrogen Management: Characterization of the Spatial and Temporal Stability of Yield Patterns.I. O 'Halloran, Univ. of Guelph
17) Plant spectral analysis during early crop growth for site-specific nitrogen fertilizer -management. P. Voroney, Univ. of Guelph
18) Nitrogen availability for high density peach orchard. M. Derkacz, Univ. of Guelph
19) Foliar nutrient supplement for grapes, peaches and nectarines. M. Derkacz, Univ. of Guelph
20) Nitrogen losses from fall applications of liquid dairy manure. H. Blais, Univ. of Guelph
21) Soil fertility factors affecting isoflavone content in soybeans. T.Q. Zhang, V. Poysa, T. Welackey, I. Rajcan (Univ. Guelph), T. Bruulsema (PPIC), C. J. Jackson, G. Ablett, P. Goodwin (Univ. Guelph).
22) Nitrogen Management for Controlling Petiole Spotting (Gomasho) of Chinese Cabbage. J. Warner, R. Cerkauskas and T. Q. Zhang (GPCRC - AAFC).
23) Optimum nitrogen fertilization for enhanced earliness and reducing the fruit maturity period of processing tomatoes with maximum yield. J. Warner and T. Q. Zhang (GPCRC - AAFC)
24) Field measurement of nitrogen mineralization in heavy clay soils with addition of red clover. T.Q. Zhang, C.F. Drury, and C.S. Tan (GPCRC - AAFC).
25) Seasonal trends of crop growth efficiency - Radiation and water use efficiencies as a function of nutrient management and climate. E. Pattey, I.B. Strachan in cooperation with J. Boisvert (Sainte-Foy) - AAFC Ottawa, 1999
26) Organic soil amendments as factors influencing soil tillage energy efficiency. N. McLaughlin, E. Gregorich, L. Dwyer, B. Ma, C. Topp and with Charlottetown, AAFC Ottawa, 1991.

27) Management of mycorrhiza in Corn production. S. Nelson - AAFC, Ottawa 1996
28) Crop-based Indicators for Monitoring Spatial Variability and Corn Nitrogen Management. B. Ma - AAFC, Ottawa, 1997.

3. Water Management

1. Field techniques for estimating soil hydraulic properties and waste water trench design. D.Elrick and G.Kachanoski - Univ. of Guelph.
2. Identification of indicator bacteria of rural wells and stratigraphies conductive to bacterial transport. D.Joy - Univ. of Guelph.
3. Steady-state baseline N leaching. Univ. of Guelph (P. Groenevelt), GPCRC, AAFC, Harrow (C. F. Drury, C. S. Tan, W. D. Reynolds)
4. Development of a multi-stakeholder process for resolution of rural-urban conflict over groundwater issues. S.Hilts - Univ. of Guelph.
5. Field assessment of leaching bed performance. H. Lee, D. Joy - Univ. of Guelph.
6. Detection and Quantification of Cryptosporidium Parium oocysts in water. H.Lee, M.Griffiths, J.Barta, J.Trevor - Univ. of Guelph
7. Quantifying water quality impacts of livestock farms and other rural land uses. R. Fleming, Univ. of Guelph (#23770) - 4-years (considers a number of management practices that affect the potential for surface water contamination following land application of manure.)
8. Prevention of water resources contamination with potentially pathogenic faecal bacteria from manure following field application. M. Goss, Univ. of Guelph (#24020) 3-years (developing improved guidelines for land application of wastes to prevent bacterial contamination surface and ground water. Methods to quantify the numbers of potential pathogens applied to the soil during field application of organic waste, and to quantify the transport potential of the pathogens through the soil will be evaluated.)
9. Risk of surface runoff and subsurface drainage from agricultural regions (ONT). R.Rudra, M. Goss, G.Kachanoski, C.Wagner-Riddle, H. Whiteley - Univ. of Guelph.
10. Integrated Water Management for rural Ontario. R. Kruetzwiser, R. deLoe - Univ. of Guelph.
11. Urban-RURAL water conflict: an economic analysis of institutions governing groundwater use in Ontario. K. Rollins, J. Fitzgibbon, G. Fox - Univ. of Guelph.
12. Investigations of riparian buffers and wetlands for management of agricultural non-point source pollution. N. Kaushik, A. Gordon, R. Rudra, H. Whiteley, R. McBride - Univ. of Guelph.
13. Improvements in modelling P dynamics in wetlands. I. Heathcote - Univ. of Guelph.
14. Amelioration of nitrate-contaminated groundwater in rural Ontario. W. Chesworth - Univ. of Guelph.
15. Overseeding cereal rye into standing corn to test effects on crop yields and movement of nitrates. B. Ball Coelho (SCPFRC) and R.C. Roy (SCPFRC).
16. Irrigation and water budgets for turfgrass. Bob Sheard and Gary Parkin (U. of Guelph). Measurements of agricultural impacts on water quality, and the development of management practices to protect water resources. R. Fleming (U. of Guelph)
17. Effects of controlled drainage/subirrigation on processing tomato, corn and soybean yields and water quality at field scale. GPCRC, AAFC, Harrow (C.S. Tan, C.F. Drury, J.D. Gaynor, T.W. Welacky).
18. Nitrate-Nitrogen Leaching - a modelling study. B. Ball-Coelho, SCPFRC, AAFC, Delhi
19. Alfred Wetland - C. Weil, Alfred College, Univ. of Guelph (pilot constructed wetland system for Village of Alfred - 1999-2000)
20. Constructed Wetland Guidance Manual - C. Weil, Alfred College, Univ. of Guelph
21. Effects of trickle irrigation on processing cucumber yield and quality for crops grown on a Fox loamy sand soil. B. Reynolds, SCPFRC, AAFC, Delhi. Apr. 1/99 - Mar. 31/02.

4. Soil and Crop Management

1. Performance of wheel and track running gear on liquid manure tankers. R.McBride - Univ. of Guelph.
2. Field validation and sensitivity analysis of the WheelVB model. M. McBride, Univ. of Guelph (#23710) 2-years (providing a field-tested model for the soil compaction and rut development under liquid manure tankers)
3. Influence of management on soil processes and void networks. R.Protz - Univ. of Guelph.
4. Soil Management Research for Field Crops.D. Y oung, Univ. of Guelph.
5. Environmental evaluation of zone tillage, no tillage, and conventional tillage systems for corn & soybean production in Southwestern Ontario. U. of Guelph (T Vyn), GPCRC, AAFC, Harrow (C.F. Drury, C.S. Tan, W.D. Reynolds, T.W. Welacky, A.S. Hamill, S.E. Weaver, T.O. Oloya, C.Fox).
6. Evaluating short versus long-term no-tillage and conventional tillage systems for soybean and corn production on a clay loam soil in Southwestern Ontario. GPCRC, AAFC, Harrow (C.F. Drury, W.D. Reynolds, C.S. Tan, T.W. Welacky, J.D. Gaynor, T.O. Oloya, C.A. Fox; SCPFRC, AAFC, London (E. Topp, J. E. Traquair, ECORC, AAFC, Ottawa (E.G. Gregorich).
7. Tillage (conventional, no-till, chisel and zone tillage) systems for processing tomatoes John O'Sullivan, (U. of Guelph), C. Swanton (U. of Guelph) and T. Vyn (U. of Guelph).
8. Development of methodology using image analysis technology to quantify soil aggregate distribution thereby facilitating the assessment of soil structure formation as impacted by conversion of tillage practices. C. Fox (SCPFRC).
9. Effects of cropping and tillage practices on soil quality. R. Beyaert (SCPFRC) and P. Voroney (U. of Guelph).
10. Evaluation of zone tillage effects on limitations to successful no-till corn production. SCPFRC, AAFC (R.P. Beyaert, B. Ball Coelho, R. Chapman and R. Roy).
11. Quantifying the detrimental effects of improperly timed cultivation under no-till and conventional till practices. W.E. Curnoe, C. Topp, E. Gregorich, D. Lappan, N. McLaughlin.
12. Long-term effects of fertilization and rotation on soil quality and crop productivity. GPCRC, AAFC, Harrow (C.F. Drury, C.S. Tan, W.D. Reynolds, ECORC, AAFC, Ottawa (E.G. Gregorich, U. of Guelph (P. Groenevelt , H. Dadfar.
13. Corn root systems under long-term fertilization and crop rotation: a minirhizotron study. T.Q. Zhang, C.F. Drury, C.S. Tan, D. Reynolds (GPCRC).
14. Optimizing soil and crop management practices for soils in E. Ontario. B. Curnoe (U. of Guelph).
15. Evaluation of environmental impact of continuous vegetable production in organic and conventional farming systems. SCPFRC (J. Tolman, C. Fox, E. Topp, R. Chapman).
16. Development and measurement of soil parameters that indicate and/or quantify soil physical quality for high output and environmentally sustainable field crop production. GPCRC, AAFC, Harrow (W.D. Reynolds, C.F. Drury, C.S. Tan).
17. The effects of surface applied versus no-till incorporated lime. D. Young (U. of Guelph) and J. Gaynor (GPCRC).
18. Fungal Bioindicators of Tillage Practices. J. Traquair, SCPFRC, AAFC, London.
19. Soil faunal interactions with physical and chemical soil attributes for no-till and conventional practices at field and landscape scale. C. Fox, SCPFRC, AAFC, London. (Testing of bait lamina technology as an indicator of extent of biological activity).
20. Nitrogen Fertilization of Forage Millet and Sorghum. R. Beyaert, SCPFRC, AAFC, Delhi.
21. Assessments and interpretations of agro-climatic resources under existing and changed climate scenarios. The focus is on indices for available soil moisture and thermal units for crop production. A. Bootsma, R. DeJong and H. Hayhoe - AAFC, Ottawa, 1999.
22. Development of measurement platforms and data quality assurance for ground-based hyperspectral reflectance. I.B. Strachan, E. Pattey, D. Dow, A. Saumure, M. Lefebvre - AAFC Ottawa, 1999
23. Stress detection and yield prediction using ground-based and airborne hyperspectral reflectance. E. Pattey, I.B. Strachan, N. McLaughlin in cooperation with J. Boisvert (Sainte-Foy) AAFC Ottawa, 1999.

24. Mathematical modelling of the soil/plant/atmosphere system. D. Stewart - AAFC, Ottawa, 1996
25. Identifying Soil-Related Limitations to No-Till Corn Production. C. Topp, B. Curnoe (U. of G.), E. Gregorich, AAFC in cooperation with OCPA, Ottawa,1996.
26. Development and evaluation of a portable soil cone penetrometer to measure soil strength and water content. C. Topp, D. Lapen, B. Curnoe (U. of G.) and in cooperation with Environmental Sensors Inc.- AAFC, Ottawa, 1996.

Site Specific Crop Management

1. Correlation of site-specific crop yield data to airborne and satellite imagery. R.Protz - Univ. of Guelph.
2. Site-specific crop management. I. O'Halloran, Univ. of Guelph, Ridgetown.
3. Prediction of yield variability using 'Crop Scan' instrumentation. B. Ma, N. McLaughlin, B. Vigier, L. Dwyer - AAFC, Ottawa, 1999.
4. Spatial variability of tillage energy requirements. N. McLaughlin, C. Topp, E. Gregorich, B. Curnoe (U. of G.), and D. Lapen - AAFC, Ottawa, 1996.
5. Developing improved methodologies for characterizing spatial and temporal variability in agro-climates using geostatistical and data mining techniques. D. Lapen and H. Hayhoe - AAFC, Ottawa, 1999.

Integrated Pest Management

1. Effect of rotational crops on suppression of populations of P. *penetrans*. SCPFRC, AAFC (B. Ball Coelho, E. Riga, R.C. Roy).
2. Rotation Crop Management for biological control of nematodes. B. Reynolds, SCPFRC, AAFC, Delhi Apr. 1/95 - Mar. 31/99.
3. Biological control of soilborne pathogens. R. Reeleder, SCPFRC, AAFC, Delhi
4. Use of composts to control soilborne diseases of ginseng. R. Reeleder, SCPFRC, AAFC, Delhi.
5. Stimulation of pesticide-degrading microorganisms in soil. E. Topp, SCPFRC, AAFC, London
6. Automated weather station data and numerical weather estimates in crop disease management. T. Gillespie - Univ. of Guelph.
7. Using IR imagery and airborne hyperspectral reflectance for early disease detection in crops. B. Vigier, E. Pattey, I.B. Strachan - AAFC in cooperation with J. Miller (York U.), 1999
8. Assessment of the influence of manures for the control of soilborne pests. G. Lazarovits, SCPFRC, AAFC, London

5. Best Management Practices (BMPs)

1. Development of an analytical support package for farmer groups to implement BMPs for N. M.Goss, G.Thurtell and C.Wagner-Riddle, Univ. of Guelph.
2. Evaluation of best management practices for increasing nitrogen use efficiency on farms. M. Goss, Univ. of Guelph

6. Biosolid / Waste Application and Treatment

1. Toxic elements in biosolid amended soils. L.Evans, Univ. of Guelph.
2. Management of municipal sewage application to agricultural land. P. Voroney, Univ. of Guelph.
3. An evaluation of agronomic and environmental effects of application of composted source separated solid waste to agricultural land. GPCRC, AAFC, Harrow (C.F. Drury, W.D. Reynolds, C.S. Tan, K. Denholm; RCAT, U. of Guelph (R. Fleming).
4. Effects of compost on processing crop production and soil and water quality under large scale no-till and conventional-till fields. GPCRC, AAFC, Harrow (C.S. Tan, C.F. Drury, W.D. Reynolds, J.D. Reynolds, T. Zhang).
5. Compost materials for turfgrass. Ken Carey and Greg Boland.
6. Optimizing the value of paper mill biosolids as a soil amendment on agricultural land in eastern Ontario. W.E. Curnoe, Univ. of Guelph.
7. Application of Sewage Biosolids to Agricultural Land – Implications for Current and Future Productivity. Univ. of Guelph (#24280), B.A. Hale.
8. Application of Paper Mill Biosolids to Agricultural Land - Benefits and Best Management Practices. P.Voroney, Univ. of Guelph; Organic Resource Technologies Inc. (industry funded study to determine the benefits that result from the utilization of high C:N ratio (high carbon and low nitrogen content) paper mill biosolids on agricultural land.)
9. Conditioning of degraded and marginal soils with paper mill biosolids prior to planting grapes, peaches and agricultural crops. P.Voroney, Univ. of Guelph
10. Agronomic evaluation of lime stabilized sewage sludge for field crop production and impacts on soil biological, chemical and physical quality. AAFC, GPCRC/SCPFRC, Harrow and London (E. Topp, C. Fox, C. Drury, D. Reynolds, T. Welacky, J. Tolman).(5th yr of 6 year study)
11. Persistence and impacts of endocrine-disrupting chemicals. E. Topp, SCPFRC, AAFC, London.

7. Greenhouse Gas Emissions

1. The influence of carbon sources, water and oxygen effects on nitric oxide and nitrous oxide emissions from soils. C. F. Drury (GPCRC), D.J. McKenney (U. of Windsor), S.W. Wang (U. of Windsor).
2. Diffusion systems within and above tall vegetation G. Thurtell, C.Wagner-Riddle (U. of Guelph).
3. Evaluation of environmental impacts of manure treatment technologies. R.Fleming, Univ. of Guelph (#23780) 4-years (release of greenhouse gases during the composting of liquid swine manure; release of odour from swine barns and manure storages.)
4. Economic assessment of mitigation scenarios for greenhouse gases in agriculture. A. Weersink, Univ. of Guelph (#24290) 1-year (estimating the costs associated with the various mitigation strategies considered by the Agriculture and Agri-Food Climate Change Table.)
5. Modelling the fate of gaseous agricultural pollutants. G. Edwards, Univ. of Guelph (#24300) 2-years (providing an improved model for the short and medium distance transport of odours and gases from agricultural buildings. The goal is to develop a tool for determining minimum distance separation between farm and non-farm buildings.)
6. Ammonia and N gas Loss resulting from manure application. G.Thurtell, C. Wagner-Riddle - Univ. of Guelph.
7. Cropping systems and tillage effects on soil organic matter, for reducing ghg impacts. R. Beyaert, SCPFRC, AAFC, London.
8. Greenhouse gas emissions, removal of air pollutants and nitrate leaching in management systems designed for carbon sequestration. C. Wagner-Riddle ,Univ. of Guelph.
9. Development of improved trace gas flux measuring systems and data management using relaxed eddy accumulation and eddy covariance techniques. E. Pattey, A. Jones, D. Dow, M. Lefebvre, A. Saumure - AAFC, Ottawa, 1999.
10. Evaluating and improving the parameterization of biogeochemical processes associated with the flux of N_2O from Canadian agroecosystems. R.L. Desjardins, E. Pattey, W. Smith, S. Kaharabata - AAFC, Ottawa, I. MacPherson (NRC), C. Wagner-Riddle (U.Guelph), R. Grant (U. Alberta), 1999
11. Assessing the nitrous oxide tradeoffs to carbon sequestering management practices. R. Lemke (Swift Current), E. Pattey - AAFC, Ottawa, 1999
12. Crop yield variability under climate change scenarios for selected sites in Ontario and across Canada. R. DeJong, S. Gameda and A. Bootsma - AAFC, Ottawa, 1999.

General

1. A farming systems approach to assessing the sustainability and health of food production systems in Ontario. C. Swanton (U. of Guelph).
2. Environmental risks, policy changes and resource management in agriculture. B. Smit - Univ. of Guelph.
3. Regional environmental information system for sustainable rural development of the United counties of Stormont, Dundas and Glengary. I. Jarvis - AAFC (in collaboration with United Counties of Stormont, Dundas and Glengary), Ottawa, 1998-2000.
4. Development of improved autostation data management and implementation of new technology to provide improved real-time Internet access to the Ottawa CDA autostation. H. Hayhoe, A. Jones and D. Balchin - AAFC, Ottawa, 1999.
5. To develop a methodology of assessing and predicting the environmental, soil and crop production and economic implications of various policy and program scenarios. E. Huffman - AAFC, Ottawa, 1999.
6. Risk of winter injury under climate change scenarios. A. Bootsma (in cooperation with Sainte-Foy) AAFC, Ottawa, 1999.
7. Maintenance and upgrade of land resource database for selected counties in eastern Ontario and western Quebec. I. Jarvis, D. Kroetsch, P. Schut in collaboration with OMAFRA, MAPAQ and Ste-Foy Centre - AAFC, Ottawa, 1999.
8. Evaluation of soil quality change and updating soil information for the county of Renfrew, Ontario. D. Kroetsch - AAFC (in collaboration with Renfrew county), Ottawa, 1998-2000.
9. Regional environmental information system for sustainable rural development of the United counties of Prescott and Russell. I. Jarvis - AAFC (in collaboration with Prescott and Russell United Counties), Ottawa, 1998-2000.

APPENDIX V

ISSUE CHAMPION REPORTS

Infrastructure Issue - Soil Resource Management - Larry Schut, OMAFRA.....V-2

1. Manure Management - M. Goss, Univ. of Guelph.....V-5

2. Nutrient Use Efficiency - I. O'Halloran, Ridgetown, Univ. of Guelph.....V-9

3. Water Management
   a) Wetland/Waster Water - C. Weil, Alfred, Univ. of Guelph.....V-15
   b) General - Tiffany Svensson, Ontario Federation of Agriculture.....V-24

4. Soil and Crop Management - C. Drury, GPCRC, AAFC.....V-26

5. BMPs - D. Aspinall, OMAFRA.....V-30

6. Biosolid / Waste Application and Treatment - Larry Schut, OMAFRA.....V-34

7. Agriculture and Agri-food Table on Climate Change - Maria Alles deVos.....V-35

Infrastructure Issue - Soil Resource Management

Larry Schut, OMAFRA, Guelph

ISSUE: SOILS INFRASTRUCTURE

There has been considerable progress made in terms of provincial initiatives and inter-agency cooperative efforts to develop a soils information database for Ontario and make the information accessible to users.

1. Provincial Initiatives

1. Information and Information Technology Clusters

The Ontario government initiated the development and implementation of Information and Information Technology (I&IT) clusters. Ministries that develop and/or maintain information databases, prepare/publish information, or deliver information programs of similar types (e.g. physical resources mapping), were 'clustered' and given a mandate to develop a streamlined information delivery system.

There is a 'Land Resources' I&IT cluster involving the Ministry of Natural Resources (lead), Ministry of Agriculture, Food and Rural Affairs, Ministry of the Environment, and Ministry of Northern Development & Mines. This cluster has implemented a formal structure called *Land Information Ontario* (LIO), which is responsible for land information database development and warehousing.

1.2 Land Information Ontario (LIO)

LIO has recognized the importance of soil resource information as 'core data' at the provincial level. It has been agreed by the Land Resource cluster and LIO, that soil resource information needs to be captured in a form compatible with the Ministry of Natural Resources data management system called 'Natural Resources and Values Information System' or NRVIS.

1.3 NRVIS

NRVIS has been chosen as the database management system to be used to warehouse land resource information for Ontario. NRVIS has specified attributes, standards, and other quality assurance requirements.

2. Cooperative Projects and Endeavors in Soil and Water Resource Mapping

2.1 Soils Ontario

Soil map information was recognized by LIO as an important core data need in NRVIS. The objective of Soils Ontario is to improve and upgrade the mapping and make it available through NRVIS. OMAFRA, OMNR, and AAFC are the lead agencies. Contributions also from MNDM, MOE, U of G. The aims of Soils Ontario are to upgrade soil map coverage of Ontario by:

1. Creating a seamless digital soil map coverage for Southern and Eastern Ontario. Currently all county and RM soil maps are digitized and existing in individual digital files organized by county soil map coverage.

2. Enhancement, upgrade and improvement of the seamless digital coverage by:
   - the undertaking of ambitious correlation tasks to correct mapping and classification mismatches across municipal boundaries and between and within correlation regions;
   - using digital elevation models (DEM's) to automatically generate slope classifications for soil mapping where these are presently lacking (approximately 50% of Southern Ontario);
   - finalize and publish updated and amalgamated guidelines *Soil Capability Classification for Agriculture in Ontario.* Apply these guidelines to the upgraded seamless digital soil map data;
   - undertake a field program involving on a selective and planned basis:
     1. Checking quality and accuracy of computer slope class generations
     2. Sampling of selected sites to add to key representative soil attribute files and to test ped transfer functions developed to estimate some soil properties
     3. Further investigation and solution of correlation problems.
     4. Reclassify the Canada Land Inventory for all upgraded areas using latest iteration of the regional CAI guidelines developed for Ontario.

3. Upgraded seamless files made available through NRVIS.

4. Devise approaches and develop data standards for soils mapping upgrades in Northern Ontario.

2.2 Soil Survey Upgrades

Participants: OMAFRA, AAFC, Respective Eastern Ontario municipalities, OMNR. Completed projects in Russell-Prescott, Stormont-Dundas-Glenngary, and Renfrew have been followed by the Leeds-Grenville upgrade project in 1999. There is also interest from Lanark to have its soil mapping upgraded as well. These projects have been very successful and are including internet accessibility to the upgraded map and interpretive information. These projects are being led by Agriculture and Agri-Food Canada with professional support from OMAFRA, with the full endorsement and significant resource support by the respective municipalities. New soil capability classifications (CAI) were derived for the upgraded soil mapping for application to municipal planning.

These projects enabled the development and trial of a methodology for upgrading soil maps built around the application of DEM's to classify land slopes followed by automatic and manual evaluation of the original soil map polygons in light of the slope characterization information provided by the DEM. Application of this methodology will serve as a main component of the upgrade works proposed under Soils Ontario.

2.3 Digitizing OMAFRA Drainage Maps

Tile Drainage mapping is being digitized and will be a core data attribute in NRVIS. The present digitizing project is by agreement amongst OMAFRA, AAFC, and the Ontario Association of Land Surveyors.

2.4 Partnering with Ecological Land Classification Data Collection

The Ecological Land Classification (ELC) system is an important tool for the evaluation of natural lands and the collection of data (including soils) to standards developed by OMNR. Municipalities, Conservation Authorities, and forestry companies are expected to rely increasingly on this system to inventory natural lands.

The soil classification component of the ELC affords an opportunity to share geo-referenced soil profile data that is ultimately beneficial to Soils Ontario with its upgrade objectives. At present there are 1500 ELC plots including soil data which have been compiled by OMNR.
OMNR foresees the need for effective training in ELC data collection and classification for personnel hired in that role by the aforementioned agencies. This will ensure data standards satisfactory to OMNR and also Soils Ontario and its participating agencies.
OMAFRA will assist OMNR with the soils component of its ELC training program.
AAFC is overseeing the development of further data standards with respect to soils to ensure future soils data collection under ELC will meet Soils Ontario upgrade standards.
OMNR also has Growth and Yield Program plot soil data. The usefulness of this data is also being evaluated for soil map upgrading.

2.5 Incorporation of MoE Waterwell Records into NRVIS

This has also been recognized by LIO as a core data set under NRVIS. It is currently in the planning stages, and will require considerable effort to bring it into NRVIS.

5-1. MANURE MANAGEMENT ISSUE CHAMPION REPORT

Michael J. Goss
University of Guelph

1. Introduction

Manure management continues to dominate newspapers, particularly in conjunction with the issues around new barns and contamination of Lake Huron with material leaking from underground manure storages.

Nutrient management is still a major driver for research into manure management. NMAN99, the decision support system for manure application developed by Don Hilborn of OMAFRA, has become the major regulatory tool for developing nutrient management plans in Ontario and New Brunswick. It is also in use in Manitoba.

Bruce Bowman was appointed the convener of the CARC Expert Committee on Manure Management, and is a member of the Canada Committee on Natural Resources. ManureNet, the web-site that Bruce developed, has continued to be enhanced.

A successful meeting, with support from the National Soil and Water Conservation Program, was held in Niagara Falls during March to look at different aspects of nutrient management.

The following report covers the research in progress during 1999.

2. University of Guelph Research

There were some significant achievements to report from the Natural Resources & Environment Program :

MCLONE4 - the decision support program for manure management for dairy and swine was completed. In addition to these two species, the program is also able to deal with poultry systems, and algorithms for beef are present, but not activated. A model that uses convective and diffusive transport to describe a worst-case scenario for odour transmission has been produced, and is included on the same diskette as the main MCLONE4 program.

Tunable diode laser detection systems for NH_3, N_2O and No_x were thoroughly tested for field use. The release of greenhouse gases, especially N_2O, was investigated for solid manure in storage and after land application. A good correlation was found between the release of NH_3 after land application of solid manure estimated by a micro-met study, using a tuned-diode laser detector, and a simple method using passive flux tubes.

A composting unit has been established at Ridgetown College. It uses liquid swine manure as the N source and a variety of carbon sources have been investigated. It was aimed at evaluating composting as a technique to reduce odour emissions from liquid swine manure.

A new program, the Resources Management & Environment Program, has been developed. It also gives prominence to the issue of manure management. The following five projects have been funded under the issue:

Project	Title	Leader
24210	Development of a single integrated computer program for the management of manure, biosolids and mineral nutrients	Goss
24230	Risk assessment & economic evaluation of environmental damage associated with livestock manure - dietary strategies & handling alternatives	Wagner-Riddle Fan Stonehouse
23990	Impact of manure and fertilizer phosphorus applications on phosphorus availability	O'Halloran
23770	Quantifying water quality impacts of livestock farms and other rural land uses	Fleming
23760	Optimizing methods of applying animal wastes and bio-solids on the land at desired rates	Hawkins

The first project is of one year duration, and creates a single decision support system (DSS) for manure management for use in Ontario. It avoids uncertainty associated with the existence of two programs(NMAN99 and MCLONE4), and provides an enhanced DSS with respect to the options for land application techniques.

The second project is of four year duration. It will enhance the DSS by adding information on greenhouse gas emissions, and aims to provide estimates of net social welfare impacts of different manure management systems.

The third project is of two years duration. It aims at providing information for the DSS related to the leaching of phosphorus (P) compounds that are readily bio-available and can contribute to eutrophication. The project also investigates the availability of manure P to crops relative to inorganic (fertilizer) P.

The fourth project is of four years duration. It considers a number of management practices that affect the potential for surface water contamination following land application of manure.

The fifth project is of four years duration, and is aimed at improving the uniformity of solid manure application from spreaders.

In addition to these projects, several projects that relate to manure management are funded under the issue of greenhouse gas emissions and carbon sequestration, and under the 'open' category. The following projects are funded under the issue of greenhouse gas emissions and carbon sequestration

Project	Title	Leader
23780	Evaluation of environmental impacts of manure treatment technologies	Fleming
24290	Economic assessment of mitigation scenarios for greenhouse gases in agriculture	Weersink

The first projects is of four years duration. It aims to deal with the release of greenhouse gases during the composting of liquid swine manure. It will also address the release of odour from swine barns and manure storages.

The second project is of one year duration. It aims at estimating the costs associated with the various mitigation strategies considered by the Agriculture and Agri-Food Climate Change Table.

The following projects are funded under the 'Open' category.

Project	Title	Leader
24300	Modelling the fate of gaseous agricultural pollutants	Edwards
23710	Field validation and sensitivity analysis of the WheelVB model	McBride
24020	Prevention of water resources contamination with potentially pathogenic faecal bacteria from manure following field application	Goss

The first project has a duration of two years. It aims at providing an improved model for the short and medium distance transport of odours and gases from agricultural buildings. The goal is to develop a tool for determining minimum distance separation between farm and non-farm buildings.

The second project has a two years duration. It aims at providing a field-tested model for the soil compaction and rut development under liquid manure tankers. Linked to the field testing will be the development of a rapid test for determining the compressibility and state of over-consolidation of non-plastic agricultural soils.

The third project is of three years duration. It aims at developing improved guidelines for land application of wastes to prevent bacterial contamination surface and ground water. Methods to quantify the numbers of potential pathogens applied to the soil during field application of organic waste, and to quantify the transport potential of the pathogens through the soil will be evaluated. Particular attention will be given to the characteristics of the liquid phase of the waste, and their impacts on the transport process.

There are additional projects funded by the Animals Program that also relate to manure management:

Project	Title	Leader
19150	Effect of Feeding Strategy on Energy Expenditure and Amino Acid Catabolism in Visceral Organs	de Lange
22590	Optimizing Poultry Nutrition and Feed Management in Terms of Production Efficiency and Environmental Management	Leeson
22770	Amelioration of Odours from Hog Manure by Electrochemical Treatment	Bunce
23170	Application of Transgenic Methodology in Swine for Reduced Environmental Impact and Enhanced Carcass Quality	Phillips

3. Agriculture Agri-Food Canada

With the closure of the unit in Guelph, research activity related to manure management in Ontario is largely confined to work in ECORC. Some of the work formerly carried out from Guelph has been continued through National Soil and Water Conservation Program funding of a consultant.

Projects concerned with energy conservation through the use of animal manure, both from the reduction in mineral fertilizer and from reduced implement draught resulting from increased organic matter loading are being carried out by McLaughlin. Sites are located in Ontario and in Prince Edward Island. Work related to soil physical conditions following heavy applications of solid manure is in progress (Dwyer, Gregorich, Topp). Availability of N derived from different organic amendments is being carried out by Gregorich.

4. OMAFRA

Development of NMANN99 has continued to be a major focus.

5. OFEC

The partners in nitrogen use efficiency project has continued, with input from OMAFRA, the University sector, and the cooperating farmers. Four of the five enterprises involve livestock.

6. Other

Completion of work on the development of precision manure application systems that minimize N loss to ground water is being carried out by King, a partner in a private consultancy. OMAFRA staff have maintained cooperation in the project.

Ontario Pork is supporting work to identify the security of underground liquid-manure concrete storages.

7. Overview of Progress and Funding

Good progress is being made in all projects. However, we are again seeing further decline in activity in AAFC. The funding from the private sector in this area is limited, and is largely coming from recycled government monies. Research funding from the provincial government for greenhouse gas emission evaluation has been limited to meeting an April 2000 deadline, and hence has no associated experimental work. The latest RFP is a paper exercise evaluating the potential reductions in emissions from adopting best management practices. Direct emissions from livestock has been ignored, and in any case, few BMPs have ever been evaluated at a farm scale. Policy and Farm Finance Division of OMAFRA should be encouraged to consider supporting the funding of longer term in support of their activities, especially looking to examine how providing additional resources to on-going work could speed up the delivery of results.

8. Important Gaps

An index for nitrogen, comparable to the P-Index, has been identified by municipalities and regulators as an important tool necessary to help farmers improve their field application strategy.

5-2. "Nutrient Use Efficiency" Issue Champion Report

Ivan O'Halloran, Ridgetown College, University of Guelph

Background:

Efficient use of nutrients is key to the profitable and environmentally sound production of crops. Ensuring a sufficient supply of nutrients for optimum crop yield and quality is a relatively straight forward task. This task, however, becomes increasingly complex if the goal is to not to simply optimize yield and quality, but to maximize producer profits and minimize losses to other parts of the environment. Often, nutrients applied in excess of crop requirements are at greater risk of being leached into groundwater, carried with runoff into surface water, or lost to the atmosphere and thereby contributing to greenhouse gas accumulation.

There is a strong basic knowledge about managing nutrients for efficient use, but there are also some significant gaps in our knowledge. These gaps may relate to recommendations for crops which did not receive high research priority in the past, or to entirely new crops. Management practices on farms have also changed, which may require research to keep fertilizer recommendations current, or to at least validate the existing recommendations. New issues, such as greenhouse gases, may also impact on the way nutrients are managed.

Progress and Research Activity over past year:

Progress continues to be made in the understanding of nutrient interactions in manure, particularly liquid manure, and management to maximize the recovery of nutrients from manure. Research has been initiated to address the question of manure P availability and impact of manure loading rates on soil test P levels. Other projects pertaining to the management of manures can be found in "Manure Management Issue Report".

Several studies have been completed on the nutrient availability from biosolids. These have provided good information about the specific materials studied, but unfortunately the diversity of materials used does not allow direct comparison between different biosolids. Much of this research has been funded by the biosolid generator, and studies are continuing in this area.

Work is continuing in the fertilization of cole crops (N, Ca, S), HRW Wheat (N and use of urease inhibitor 'Agrotain'), muck crops, garlic (foliar sprays), tomatoes, berries crops, apples, grapes and peaches, as well as studies on placement of lime and potash in no-till systems. While some of these studies are just starting, several are well underway and can be expected to yield results in the next year or two.

Barriers to Progress:

While numerous projects are being carried out, the total amount of effort which can be expended on nutrient use efficiency is limited. The number of researchers in nutrient use continues to decline, and those people doing research are only able to commit a small part of their time to research because of other commitments. For example, many of the fertility projects conducted on berry, large fruit and other horticultural crops appears to be only a small component of the over management of these crops. The small number of researchers also limits the opportunities for collaboration and co-operation, making each researcher even less effective.

Sub-issues: * Horticultural crops - lack of recommendations research, diversity of crops and soils which should each be researched separately still remains an issue. Greenhouse gases, and the link to nutrient applications Prediction of organic N release - work is progressing in this area for major field crops systems Fertilizer applications on sensitive soils Nutrient recommendations for specialty crops and new crops Validation of recommendations

Research Recommendations

In 1998, OSWARSC put forth two recommendations under the issue of nutrient use efficiency, as well as two other recommendations which have a "nutrient use efficiency" component. These recommendations were:

ISSUE: Nutrient Use Efficiency **Recommendation 2-1 Priority 1-B:** *Improving fertility management of cereal crops, canola, horticultural crops and all crops grown on environmentally sensitive soils, for increased sustainable productivity.* Particular emphasis was placed on issues relating to the following three broad areas of crops: i) Cereals and canola: on K top-dressed on winter wheat, P, K and micronutrients on canola, chloride on cereal yields and quality; ii) horticultural crops: fertilizer recommendations (macro-, microand secondary nutrients) in terms of rates and timing of applications for both fruit and vegetable crops; and iii) crops (ginseng, cole crops, tobacco) grown on light-textured, environmentally sensitive soils. Many of the concerns raised were based on the fact that recommendations are not current with the crops, varieties and cultural practices used in Ontario agriculture today.

Recommendation 2-2 Priority 1-C: *Prediction of nitrogen release from organic sources.* Emphasis remains on the issues regarding N release from "non-commercial fertilizer" sources (manures, biosolids, cover crops, legumes). The appropriate means for predicting N release from such materials will have significant impact on the development of management strategies to: improve cost-effectiveness of nitrogen inputs; and minimize the undesirable environmental impacts (greenhouse gas emissions, groundwater contamination). In addition, the need to develop an appropriate soil N tests to be used on muck and mineral soils under vegetable production.

ISSUE: Manure Management. Nutrient Use Efficiency **Recommendation 1-1:** *Development of better manure and biosolid application methods to improve nutrient efficiency and reduce the impacts on environmental quality.* Particular emphasis was placed on manure applications in no-till systems, timing of manure application and nutrient loading, manure applications to forages, application technology for uniform spreading, and P availability and impact on soil test levels. The later issue was deemed to be urgently needed as this has a significant impact on the development of "nutrient management plans" and the P index.

ISSUE: Evaluation of Best Management Practices Recommendation 5-1: *To quantify the effectiveness of various Best Management Practices that are being recommended and implemented by the sector to reduce and/or control contamination of surface and groundwater resources by agricultural fertilizers (organic and inorganic), pesticides, and sediments.*

Current Status: As recommendations 1-1 and 5-1 fall within the mandate of other issue reports, they will not be discussed any further in this report.

With respect to recommendation 2-1, there continues to be some research effort for most of the crops listed. there has been fairly scattered activity. Currently there are studies involving muck crops (Macdonald U of G); cole crops (McKeown Simcoe) N rates for tomatoes **(Zandstra RCAT),** fertigation of tomatoes (Liptay AAFC), nutrient management in grapes and peaches **(Derkacz HRIO),** Ca on apple quality **(Gardner** OMAFRA) and N rates for rutabaga and foliar sprays on garlic **(Zandstra,** RCAT). Beyaert (Delhi, AAFC) has conducted research on fertilization of tobacco, ginseng and forage millet and forage sorghum. Smid (RCAT) has been conducting some work on N fertilization of hard red winter wheat and the use of the urease inhibitor 'Agrotain'. In addition, there are several fertility research projects involving turf grass (GTI-UofG), greenhouse nutrient re-cycling **(Dixon** UofG), container and nursery stock production (Lumis UofG).

Other activities involve deep placement studies of K and tillage (Vyn), lime and starter fertilizer applications under no-till corn (Young RCAT) and starter fertilizer and N placement under no-till (BallCoelho, Delhi, AAFC).

With respect to recommendation 2-2 most of the work continues to be related to the "Manure management" category and in particular issues involving N. Other wastes and/or N management studies include paper biosolids (Curnoe, KCAT, Voroney UofG), and use of paper wastes in quarry reclamation for vineyards (Derkacz HRIO) and crop residues, cover crops and soil management impacts on N availability to crops (Voroney UofG, Beyaert Delhi AAFC, **Drury** Harrow AAFC). Other research pertains to legume residues and available N (Kay UofG),, and N-test development or assessment for: i) soils and manures (Goss UofG), ii) soils following legumes (Beauchamp et al,) and iii) soils and sitespecific crop production (O'Halloran RCAT). Studies on baseline N leaching are continuing (Groenevelt UofG), as are studies on gaseous N losses and N budgets **(Wagner-Riddle** UofG, Gregorich et al AAFC ECORC).

Level of Activity: Overall, it undoubtedly reflects the numbers of people and dollars invested in research. Possibly some increased activity in areas of N use efficiency and impacts of management systems on greenhouse gas production.

Cooperation and Collaboration: There appears to be reasonable collaboration for the most part between individuals at different institutions, although there is room for improvement in terms of the teams of individuals and institutions involved. Potential competition between institutions for limited research funding is definitely a barrier for fostering effective collaborations.

Gaps: The majority of the effort has been placed on the issue of N management and its impact on the environment with relatively very little effort being placed on other nutrients. Research is still needed on

other nutrients and/or horticultural crops.

Partial Listing of Research Projects

Ball-Coelho: AAFC

Nitrogen placement for no-tillage systems.
Modelling nitrate leaching.

Beauchamp: U of G

New Test for Improved Prediction of Available Nitrogen (N)

Beyaert. AAFC

Impact of agronomic practices on soil quality, environmental quality and crop productivity in coarse-textured soils in Ontario.

Nitrogen mineralization of the rye rotation crop as affected by nitrogen regime and the effect on nitrogen fertilizer use in tobacco production.

Ginseng N, P & K fertilizer rate trial.

Nitrogen fertilizer rate trial for forage sorghum and forage millet.

Curnoe: U of G

Optimizing soil and crop management practices for the productive soils in Eastern Ontario.

Optimizing the Value of Paper Mill Biosolids as a Soil Amendment on Agricultural Land in Eastern Ontario

Derkacz: U of G

Improvement of fruit production through improvement of soil fertility and fruit tree nutrition.

Dixon U of G

Management and measurement techniques for greenhouse nutrient recycling

Drury: AAFC

The development of decision making tools for use in crop management systems which improve soil and water quality and reduce soil gas emissions for southwestern Ontario processing crops.

Goss: U of G

Development of a single integrated computer program for the management of manure, biosolids and mineral nutrients

Evaluation of best management practices for increasing nitrogen use efficiency on farms

Evaluation of Extraction Techniques for Estimating Potentially Available N from Manures to Crops.

Gregorich: AAFC

Dynamics of N Availability and Soil with Various Nitrogen Amendments

Managing Soil Carbon and Nitrogen Resources Sustainable Crop Production

Groenevelt: U of G

Steady-State Baseline Nitrate Leaching.

Hamill: AAFC

Effect of Narrow-row Corn on Reduced Herbicide Requirements, Soil Quality and Corn Performance

Hsiang: U of G

Turfgrass management to reduce inputs and increase stress tolerance

Kay: U of G

Prediction of Available N from Soil Organic Matter and Residual Legume Crop N

Interpreting Yield Variation from Soil Structure and Soil Water Parameters

Liptay AAFC

Improvement of knowledge of i) control of growth of transplants and vegetable crops, and ii) maximizing vegetable yield and quality and iii) composition of vegetable crops.

Lumis:

Optimizing fertilization and irrigation for container-grown nursery crops

O'Halloran: U of G

Identifying Management Units for Site-Specific Nitrogen Management: Characterization of the Spatial and Temporal Stability of Yield Patterns

Variability of Soil Phosphorus.

Impact of Manure and Fertilizer Phosphorus Applications on Phosphorous Availability

Protz: U of G

A GIS and remote sensing system for agroecosystem monitoring and site specific crop management of agricultural Ontario

Tan: AAFC

The Development of decision making tools for use in crop production systems that ensure environmental quality through management of soil and water resources

Voroney: U of G

Plant spectral analysis during early crop growth for site-specific nitrogen fertilizer - management.

Management of Municipal Sewage Applications to Agricultural Land

Application of Paper Mill Wastes to Agricultural Land

Conditioning of degraded and marginal soils with paper mill biosolids prior to planting grapes, peaches and agricultural crops

Vyn: (project still at U of G)

Potassium (K) Placement for No-till Crop Production

Enhancing Corn Productivity Through Zone-Tillage on Heavier Textured Soils

Integration of crop rotations, continuous versus rotational tillage systems, and nutrient management for sustainable corn and soybean production

Wagner-Riddle: U of G

Greenhouse gas emissions, removal of air pollutants and nitrate leaching in management systems designed for carbon sequestration

N Balance of Turfgrass.

Ammonia & N Gas Loss Resulting from Manure Application

Young: U of G

Soil Management Research for Field Crops
Lime Application in No-till Systems

5-3a. WATER MANAGEMENT (WETLANDS) ISSUE CHAMPION REPORT

Claude Weil, Alfred College, Univ. of Guelph

Ontario Rural Wastewater Centre (ORWC)

The Ontario Rural Wastewater Centre has been created by the University of Guelph (Collège d'Alfred and the School of Engineering) in partnership with the Rideau Valley Conservation Authority and many industry and government stakeholders. The Centre has demonstration sites in Central Ontario at the University of Guelph and in Eastern Ontario at the Collège d'Alfred with a satellite site at the Baxter Conservation Area to the south of Ottawa. The sites will offer a wide variety of wastewater courses utilising demonstration technologies to provide a truly hands-on learning experience. The Centre researchers bring decades of applied research experience to bear on problems related to rural and unsewered wastewaters.

Mission

To promote environmentally sustainable development of rural and unsewered areas through the effective use of wastewater disposal technologies.

Mandate

To provide training, demonstration and applied research in the areas of :

- on-site disposal of household septage;
- nutrient and agricultural waste management;
- rural municipal wastewater treatment.

Areas of Specialisation

- Research and development of wastewater treatment technologies
- Training and education

Services

- Constructed wetlands design
- Wastewater treatment systems design
- Nutrient removal technologies
- Groundwater remediation
- Third party testing
- Course development and delivery

Highlights of Accomplishments for the Centre of the Last 6-8 Months

- Hiring of co-ordinators;
- Structuring of technical committees;
- Courses taken by co-ordinators in North Carolina and Collingwood;
- Progress in the formation of the Ontario On-site Wastewater Association (OOWA);
- First OOWA newsletter distributed in September and preparation of a second for January 2000;
- Presentations at the Concrete Precaster's Association of Ontario (CPAO) and the Ontario Association of Sewage Industry Services (OASIS) annual conferences;
- Creation of a bilingual ORWC Web page on the Internet (www.orwc.uoguelph.ca);
- Over ten on-going research projects;
- Production of an ORWC brochure;

- Organisation of the 1st Annual ORWC conference to be held on March 2000;
- Construction of demonstration shelters at Guelph, Alfred and Baxter sites; Baxter site is almost completed;
- Joining the Consortium of Institutes for Decentralised Wastewater Treatment and participation at the National Onsite Wastewater Recycling Association (NOWRA) annual meeting;
- Collection and creation of course materials with a first course planned for December, 1999;
- Survey of industry for training programs curriculum preparation.

Current Projects Being Conducted Under the Ontario Rural Wastewater Centre

1. **Alfred Wetland**
   The municipal treatment lagoons for the Village of Alfred have reached maximum capacity. A pilot constructed wetland system has been built to handle at least 5% of the flow entering the Alfred municipal lagoons, approximately 21,000 m^3 per year. The purpose of the project is to improve and test the design of a treatment system composed of a constructed wetland, overland flow and phosphorus adsorption filters. A constructed wetland is a cost effective means to increase the treatment capacity of the Village fo Alfred when compared to traditional lagoons. The wetland system was operated and monitored from September to November 1999, and is going to continue to be operated and monitored from May to September 2000, by the Collège d'Alfred's ORWC site.

2. **Wetland Guidance Manual**
   The overall project consists of analysing the results obtained with constructed Wetland Treatment Systems used to treat wastewater from the Agri-Food industry and/or rural communities. With the information obtained during design, construction and operation of theses systems, a guidance manual was prepared to help others in using this technology. The objective of this effort was to provide a low cost treatment alternative to the food processing industry and other rural wastewater producers to help alleviate the financial burden of waste handling.

3. **Subsurface Wetland**
   The purpose of this relationship shall be for the Parties to collaborate on initiatives related to the treatment of wastewaters and sludges using natural system, especially constructed wetlands. Setting up, calibrating and operating a pilot scale test cells and to carry out wetland treatability tests for Jacques Whitford Environment Limited.

4. **Late Fall Application of Manure**
   A field-size research site for monitoring soil water quality in relation to manure management has been operated at the Collège d'Alfred since 1997. The testing facility consists of 12 independently drained and hydraulically isolated plots spanning a 6-acres track of clay soil. All runoff and drainage waters from each individual plot is measured and sampled in the monitoring station. The installation is being used for assessing the impact on soil waters of spreading liquid manure during the late autumn period. Nitrogen contamination of soil water is the benchmark. If shown to be as safe as spring application under specific conditions of soil, slope and weather, late fall application of liquid manure would be a most useful management tool. It would allow heavy manure

haulers on some late harvested fields when the ground is firm enough to carry the weight, while reducing soil compaction and the number of operations to perform the following spring. It may also provide the option of having manure nutrients readily available for early uptake by demanding perennial crops. The objective is to compare the environmental impact of a late-fall application with the accepted spring practice.

5. **Treatment of Manure Pile Runoff and Milkhouse Wastewater**
Manure pile runoff and milkhouse wastewater both represent a threat to rural waterways. The proposed solution is to treat the two wastewaters using a flocculation system. The objective of the research is to develop a treatment system composed of a flocculation and biofilter (i.e. Premier Tech's Ecoflo® biofiltration system) to treat a wastewater composed of manure pile runoff and seepage, and milkhouse wastewater. This unit is being installed in the dairy barn at the Collège d'Alfred. Depending on the results obtained, the effluent will either be infiltrated in the ground or discharged in surface waters. This technology aims at saving at least $4,000 per year to the dairy farmers. Nutrients will be properly managed and applied on the crops with the solid manure. Such technology will greatly reduce surface water pollution in agricultural areas, as these effluents are usually discharged in the environment without any treatment.

6. **Treatment of Phosphorus using Slag**
The objective of this project is to test slag as a medium to remove excess phosphorus. Discharge of trace amounts of phosphorus (0.3 mg/L) into receiving streams negatively effect aquatic ecosystems. Most conventional treatment technologies are incapable of reducing phosphorus concentrations to this level. It is frequently the limiting nutrient for algae growth, which reduce dissolved oxygen concentration in streams causing eutrophication. Slag, a waste from the steel industry, is known to be an effective adsorption medium for phosphorus. Therefore three slag filters have been installed at the Village of Alfred pilot constructed wetland as a polishing step for the wetland effluent. This project will evaluate six types of slag, determine adsorption isotherms and design three field pilot filters for the Village of Alfred pilot wetland.

7. **Phosphorus Removal from Septic Wastewater**
The objective of this project is to develop an on-site treatment system to remove phosphorus from septic wastewater. Much work has been accomplished by the Collège d'Alfred in understanding the processes of phosphorus removal. Alum and ferric chloride have been tested in full scale application to septic tanks and have shown good removal of phosphorus. This study will test a series of polymers, as well as adsorption media to remove phosphorus from septic wastewater. An economic and environmental analysis of the results using alum, ferric chloride, polymers and adsorption media will be used to determine an optimum phosphorus removal technique. A demonstration system utilising the optimum technique will then be established at the Collège d'Alfred. This technology attempts to keep up the increased rates of loss of large bodies of water due to eutrophication.

8. **Green Valley Environmental**
The purpose of this project is to monitor a septic unit of Green Valley Environmental Services for a period of 12 months in order to provide data to the Ontario Building Materials Evaluation Commission. The collection and analysis of 12 monthly samples for the following constituents: dissolved oxygen (DO), faecal coliforms (fc), total

suspended solids (TSS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in addition to the production of two reports after 6 and 12 months.

9. **G.P. Value Engineering**

The purpose of this project is to monitor a fast wastewater treatment system septic unit for G.P. Value Engineering Ltd for a period of 12 months in order to provide data to the Ontario Building Materials Evaluation Commission. The collection and analysis of 12 monthly samples for the following constituents: dissolved oxygen (DO), faecal coliforms (fc), total suspended solids (TSS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in addition to the production of two reports after 6 and 12 months.

10. **Sanitation of Maple Syrup Tubing**

In the spring of 1998, four independent but comparable tubing collecting networks were installed at the Collège d'Alfred maple bush. The four lines were placed in a southern sloping section of the maple bush that had sustained little to moderate damages from the January 1998 Ice Storm. Ontario Maple producers have identified the sanitation and cleaning of plastic tubing systems as a high priority for research. Bacteria and other microorganisms are known to proliferate in unclean tubing and downgrade the quality of syrup. This study tests novel backwash techniques using pressurized turbulent water with and without ozone injection, and compares their efficiency to the established standards. At present, chlorine bleach is commonly used to sanitize maple tubing systems, but it detracts from the image of a pure natural product essential for marketing. This study evaluates more environmentally friendly alternatives to the use of chlorine for sanitizing and cleaning tubing.

Wetland and Riparian Zone Management - 1999 Status Report

Claude Weil, Collège d'Alfred, University of Guelph

Wetlands are used for treating industrial wastewater, landfill leachate, mining leachate, agricultural runoff, municipal wastewater and stormwater runoff throughout North America. A database compiled by the United States Environmental Protection Agency contains an inventory of over 150 North American wastewater treatment wetlands (Brown and Reed, 1994). Although the majority of these systems have been installed in the southern United States, sewage treatment wetlands are in operation as far north as the North West Territories. The database lists nine Canadian wetland treatment systems in the following municipalities: High River, Alberta; Cobalt, Ontario; Fontanges, Québec; Listowel, Ontario; and Hay River, Northwest Territories. In Canada, constructed wetland research is increasing rapidly. It is well established in the U.S.

According to John Pries, CH2M Gore and Storrie (CG&S), in North America, there are approximately 75 and 450 constructed wetlands used for the treatment of farmstead runoff and for the treatment of municipal wastewaters, respectively.

The use of constructed wetlands for wastewater treatment is not a new idea. Ancient Chinese and Egyptian cultures made use of the pollution abatement potential of wetlands (Brix, 1994). In Europe, experimentation with aquatic plants for removing organic and inorganic contaminants from water began in the 1950's and continues throughout the 1990's. Denmark, Germany and the United Kingdom each have about 200 functional sewage treatment wetlands (Brix, 1994). Constructed wetlands have been used for sewage treatment in all regions of Europe, even in countries with harsh winters such as Norway (Jenssen et al., 1994), the Czech Republic (Vymagal, 1993) and republics of the former Soviet Union (Magmedov et al., 1994).

Treatment of stormwater runoff is important in reducing its impact on receiving streams. CG&S has been involved in several constructed wetland projects in Ontario. In late 1998 they constructed a pilot stormwater treatment wetland in Toronto. This pilot project is a small portion of a larger project to restore the historical wetlands in Toronto. The Shepard Slough Stormwater Diversion project in Calgary, Alberta, is another on-going project using wetlands for the treatment of stormwater runoff. It is intended to reduce the potential flood damage at Chestermere Lake and provide stormwater drainage for a large area in southeast Calgary region.

Constructed wetlands are often used for the treatment of farmstead runoff. This is an economical method of ensuring that surrounding surface waters are not contaminated. The Collège d'Alfred of the University of Guelph has been involved in the design, construction and monitoring of two artificial wetlands. The Dignard wetland, in Embrun Ontario, and the Vachalê wetland, in Ste-Anne des Plaines Quebec, both treat farmstead runoff. The two wetlands have been operating for 4 and 3 years, respectively. The Prairie Farm Rehabilitation Administration (PFRA) in Winnipeg, Manitoba, is currently involved in the monitoring of two constructed wetlands for the treatment of farmstead runoff. Both wetlands are already operating and being monitored.

The use of constructed wetlands in the treatment of industrial wastewater is growing. Komex is currently constructing a wetland for the treatment of hydrocarbon polluted wastewater from an oil refinery just outside of Calgary, Alberta. According to Dr. James Higgins of Jacques

Whitford, a sub-surface wetland system is being constructed to treat de-icing fluid runoff from the Edmonton Airport. Both wetlands should be in full operation as of next year.

The use of constructed wetlands as a final polishing step for municipal wastewater is increasing. The Ontario Rural Wastewater Centre (ORWC) and Stanley Consulting Group Ltd. have designed a wetland that has been constructed in Alfred Ontario as a polishing step for the municipal lagoon effluent. This wetland incorporates phosphorus adsorption filters to sustain low phosphorus concentration in the wetland effluent. The wetland has been built and began its start-up in September 1999. The wetland will be in full operation in the next operating season of May to September 2000. The ORWC will be operating and monitoring this system. PFRA have also recently constructed a wetland for the tertiary treatment of municipal wastewater in Manitoba. The wetland began its operation this year.

The ORWC, in partnership with Jacques Whitford, has constructed a pilot sub-surface wetland unit for the treatment Essex county landfill leachate. This pilot study is to evaluate the feasibility of utilising the wetland system to efficiently treat landfill leachate. This system also includes a slag filter as a polishing step for phosphorus. Should this pilot system prove to be effective, a full scale wetland system will then be designed and proposed to Essex County.

Riparian zone management is important for controlling shoreline erosion and maintaining water quality. Manon Lalonde, formerly of the University of Guelph evaluated the use of vegetative filter strips for the removal of non-point pollutants from cropland runoff. The PFRA is still evaluating the value of riparian areas in Saskatchewan. They have illustrated effective riparian management practices in collaboration with the Montana Riparian Association, the Department of Natural Resources and Conservation and other interest groups.

In 1994, under the Green Plan (Agriculture Canada), an environmental monitoring of agricultural constructed wetlands took place across the province. The objectives of the study were to first, identify approximately 12 farm sites across the province of Ontario which would meet accepted design layouts for constructed wetlands (see attached list for a brief description of each farm site constructed wetland). Second, to install equipment for the monitoring of both surface and groundwater quality at each of the identified farm sites to provide baseline water quality information. The final report from this project will document the various Constructed Wetland designs used in the study, and will provide detailed information on the instrumentation used to monitor water quality (surface, groundwater) at the sites. To date the overall final report describing the activities of all 12 farms during the Green Plan wetland project has not yet been published. However, some reports for individual farm wetlands have been written and may be available from the corresponding contact groups, listed in attached list.

The Ontario Ministry of the Environment does not presently have any specific policy or design guidelines for constructed wetlands treatment of wastewater. Any application for approval for wetlands treatment work is evaluated on the basis of accepted wastewater treatment principles, relevant data, technical literature and Ministry experience. In Ontario, experts in the field of constructed wetlands use there own expertise to teach and train other researchers. The ORWC in collaboration with Stantec Consulting Ltd. have completed a guidance manual for the design, construction and operation of constructed wetlands for rural application in Ontario. PFRA is currently reviewing the Manual. CG&S run workshops for training in the area of wetland operation and design. They have been developing a North American constructed wetland database for use in the design of future wetland projects. During the upcoming winter, December 1999 to March 2000, the ORWC and Stantec Consulting Ltd. will be establishing a

technical advisory committee with the Ontario Ministry of Environment to review the monitoring procedure and database of the Alfred Wetland. This could initialise the MOE's database on wetland systems and lead to an amendment or exemption to the MOE policy on wetlands.

Updated List of Ontario Constructed Wetlands and Filter Strips *

A. Constructed Wetlands

	County	Township	Contact	Project Description
1	Russell	Russell	*Leslie Van Clief* South Nation River Cons. Authority Berwick, ON K0C 1G0	Five cell, 1.3 ha system ***Waste Treated:*** milkhouse washwater, runoff from barnyard and manure pile
2	Essex	Maidstone	*Paul Hermans* Essex Region Cons.Auth. Essex, ON N8M 1Y6	Storage pond, switch-back marsh and polishing pond ***Waste Treated:*** milkhouse washwater and liquid manure
3	Perth	Fullarton	*Brad Glasman* Upper Thames River Cons. Authority London, ON N5V 5B9	1 acre site with sedimentation area, marsh cell, pond and vegetation filter strip (gravity) ***Waste Treated:*** runoff from manure pile and barnyard
4	Middlesex	West Nissouri	*Brad Glasman* Upper Thames River Cons. Authority London, ON N5V 5B9	20' x 60' subsurface flow, wetland system-18" deep trench filled with 3/4" round, washed stone gravel ***Waste Treated:*** household wastewater
5	Perth	Ellis	*Brad Glasman* Upper Thames River Cons. Authority London, ON N5V 5B9	oil grit separator, solids screened/holding pond for water storage/twin marshes and filter strip ***Waste Treated:*** washwater from livestock transport truck washing facility
6	Ottawa-Carleton	Rideau	*Terry Davidson* Rideau Valley Cons. Auth. Manotick, ON K0A 2N0	storage lagoon/serpentine marsh/polishing pond ***Waste Treated:*** barnyard runoff
7	Niagara	West Lincoln	*Chris Attema* Niagara Peninsula Cons. Authority Allanburg, ON L0S 1A0	
8	Niagara	West Lincoln	*Chris Attema* Niagara Peninsula Cons. Authority Allanburg, ON L0S 1A0	
9	Simcoe	Essa	*Chris Jones* Nottawasaga Valley Cons. Authority Angus, ON L0M 1B0	lagoon, serpentine marsh, polishing pond and filter strip ***Waste Treated:*** barnyard run-off and milkhouse from a dairy farm
10	Peel	Town of Caledon	*Anne Marie Weslan* Metro Toronto Region Cons. Authority Downsview, ON M3N 1S4	

B. Grass Filter Strips				
1 1	Simcoe	Spring-water	*Julie Cayley* Severn Sound RAP Midland, ON L4R 4K6	barnyard runoff is pumped to a gravel header on filter strip (300' long and 12' wide, planted with reed canary grass), while distribution pipe and gravel spreader at top-end ensures even flow (Strip has a 0.5% slope)
1 2	York	Whitchurch Stouffville	*Brian Colville* Lake Simcoe Region Cons. Authority Newmarket, ON L3Y 4X1	
1 3	Durham	Brock	*Brian Colville* Lake Simcoe Region Cons. Authority Newmarket, ON L3Y 4X1	

* Adapted from list obtained by Leslie Van Clief of South Nation River Conservation Authority and is being updated as several individuals have been contacted.

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Hurd, S., C. Weil, J. Higgins. 1999. *The Use of An Engineered Wetland System to Treat Farmstead Runoff.* 4th International Conference on Ecological Engineering, As, Norway.

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5-3b. WATER MANAGEMENT ISSUE

Tiffany Svensson, Ontario Federation of Agriculture

More than 90% of Ontario's agriculture relies on groundwater. Water is not only essential to life it is also a key input component in gaining production efficiencies. Through the Ontario Farm Environmental Coalition's Water Quality Working Group (WQWG), OFA has identified the following issues:

Nitrogen-Use Efficiency: The *Partnerships in Nitrogen-Use Efficiency* (PINUE) project in the Regional Municipality of Waterloo has completed the baseline monitoring of whole farm nitrogen balances on five farms. The whole farm nitrogen balances range from -65 to +233 Kg N/ha. A selection of Best Management Practices (BMP) have been prepared for each participating farmer based on the whole farm nitrogen balance calculated from field scale data. The farmers will be able to address any identified inefficiencies by choosing to adopt some or all of the BMP recommended. Monitoring of nitrogen and water fluxes as well as economic impacts on the farms will continue over the next two years after BMP have been implemented. The three objectives of this study are to:

1. demonstrate the feasibility of improving nitrogen use efficiency on farms by operators choosing to adopt current BMP;
2. assess the impact of adopting current BMP on the quality of water moving to groundwater resources; and
3. investigate a cooperative process for the assessment of nitrogen management concerns and implementation of farm-specific solutions that meet the needs of all stakeholders.

There is a paired study addressing baseline (or natural) nitrogen leaching from below the rooting zone under different crop rotations and soil conditions. In this baseline study a more detailed monitoring approach is performed involving a test strip where zero nitrogen is applied under typical cropping practices on the farm. In addition to a number of other sites, the five Waterloo farmers have agreed to participate in this paired study.

Baseline Water Well Testing Program: Establishing a benchmark for well water quality is strongly recommended. Many perceive confidential private water well testing and interpretation as confusing and expensive. The OFA is managing a province wide program on behalf of the Ontario Farm Environmental Coalition which dispels this perception. The program enables individuals on private water supplies to protect their businesses, themselves and their families' health by establishing a baseline for water quality. This information can be invaluable later should the water quality deteriorate. A baseline water quality test can also provide early detection of water quality and quantity problems.

To date 196 wells have been tested across the province at a rate of approximately 4-6 new wells each week. OFA received approximately 6 program enquires a day. Several County Federations and groups have chosen to promote the Baseline Water Well Testing Program through special events, press releases, and subsides. Brochures outlining the program in more detail can be obtained through the OFA. Orders can be placed at the Toronto office.

Prioritizing Water Use: Low water levels and reduced precipitation rates have been reported for the past three years in many parts of Ontario. Data supporting climate change models continue to provide fuel for concern. In May 1999 a moratorium on new Permits To Take Water

was issued by the Ministry of Environment (MOE). In July 1999 this moratorium was lifted. The Ministry of Environment however, continues to curtail the issuance of new permits to take water by imposing a greater amount of scrutiny to each application particularly in areas were low water levels have been an issue in the past.

The *Permit To Take Water Program* has proven to be unreliable during periods of water shortage. The system is complaint driven and sets few priorities beyond domestic, livestock, and emergency water uses. This has the potential for serious conflict in areas where irrigated crops are a major commodity. The OFA has been working towards a consensus on a provincial water management strategy from an agricultural perspective. Agriculture needs to galvanize the debate and legislative framework for fresh water management in Ontario to protect its interests in the available water resources. The OFA has therefore been working closely with the Inter-Ministerial Water Management Committee. This committee is co-chaired by the Ministry of Environment and the Ministry of Natural Resources and includes the Ontario Ministry of Agriculture Food and Rural Affairs, Ontario Ministry of Municipal Affairs and Housing, and the Ministry of Economic Development and Trade.

In preparation for a dry growing season in 1999, the OFA through the Ontario Farm Environmental Coalition's Water Quality Working Group (WQWG), participated in an effort to develop several information sheets published through the Ontario Ministries of Agriculture Food and Rural Affairs and the Ontario Ministry of Environment. These documents were designed to provide a first step to addressing water shortages and can be viewed on OFA's web site and were promoted at the County Federations.

In a nutshell farmers want more security in accessing water supplies. Furthermore, farmers feel a priority needs to be set for all of agriculture above other purposes such as cosmetic uses (e.g. lawn watering and car cleaning). In the summer of 1999 water shortages and water management had an increased profile in the media. OFA continues to capitalize on this increased public attention.

5-4 Soil & Crop Management Issue Champion Report

C.F. Drury,
Greenhouse & Processing Crops Research Centre (GPCRC),
Agriculture & Agri-Food Canada, Harrow, Ontario

Soil and Crop Management Research in Ontario can be divided into the following research areas:

1. Tillage research to overcome limitations of no-till in clay and clay loam soils
2. Organic amendment applications to improve soil quality by increasing organic matter, improving soil physical properties and/or enhancing nutrient availability.
3. Crop rotation systems to improve soil quality and reduce diseases.
4. Water table management and irrigation technology to alleviate drought stress and thereby improve crop growth, enhance nutrient uptake and/or improve water quality.
5. Greenhouse gas/Carbon sequestration research to improve soil and environmental quality.
6. Soil quality & process studies

There are at least 7 tillage studies that are being conducted in Ontario to identify and to develop solutions to the problems associated with no-till and conservation tillage systems. For example, zone tillage systems look particularly promising by improving early seedbed conditions while maintaining some of the benefits of a conservation tillage system as about 3/4 of the area is not tilled.

Research using organic amendments has increased to address the viability of using the variety and quantity of composted material available for use on farm land. The desire to increase soil organic matter, to reduce odors (from animal manures such as liquid pig manure) and to divert organic wastes from land fills will result in the increased use of these materials. Hence research is needed to determine both the short and long-term effects of these composted and organic materials to ensure that food safety, soil, air and water quality are improved. This is one research area which is anticipated to expand over the next decade.

Crop rotation systems have been an integral part of BMP. In addition to the traditional use of crop rotation systems there has been additional interest in including cover crops such as red clover and cereal rye. Cover crops can be used to increase C sequestration; reduce wind erosion and damage to young seedlings such as tomato transplants; to reduce disease pressure (SCN, P. penetrans, etc.) and to capture residual nutrients such as nitrate in the fall and increase their availability to the subsequent crops.

Water Table Management Systems can be used to overcome dry soil conditions which stress plants and results in lower yields and N uptake. When crop growth is reduced, there is greater amounts of residual nitrate in the soil which could leach out under the wet soil conditions of fall and spring and cause surface and groundwater contamination. A watertable management system can be used to increase crop growth and nutrient uptake and reduce nitrate leaching by about 50%. New fertigation technology is also being used on high valued

crops to reduce nutrient leaching and to ensure that these crops have sufficient water and nutrients during the growing season.

Canada's commitment to reducing greenhouse gas emissions will lead to the adoption of soil and crop management practices which increase C sequestration. By increasing soil organic matter, there will be many additional benefits such as improved structure, improved water retention and transmission, increased soil fertility and improved crop productivity. Other approaches to reducing greenhouse gas emissions should also be studied to ensure that agricultural practices contribute to improved environmental quality.

Soil and Crop Management Research Studies in Ontario

Tillage Research

1. Environmental evaluation of zone tillage, no tillage, and conventional tillage systems for corn & soybean production in Southwestern Ontario. T Vyn, (U. of Guelph), C.F. Drury (GPCRC), C.S. Tan (GPCRC), W.D. Reynolds, T.W. Welacky (GPCRC), A.S. Hamill (GPCRC), S.E. Weaver (GPCRC) and T.O. Oloya (GPCRC).

2. Evaluating short versus long-term no-tillage and conventional tillage systems for soybean and corn production on a clay loam soil in Southwestern Ontario. C.F. Drury (GPCRC), W.D. Reynolds (GPCRC), C.S. Tan (GPCRC), T.W. Welacky (GPCRC), J.D. Gaynor (GPCRC), T.O. Oloya (GPCRC), C.A. Fox (GPCRC-SCPFRC), E. Topp (GPCRC-SCPFRC), J. E. Traquair (SCPFRC), and E.G. Gregorich (ECORC).

3. Tillage (conventional, no-till, chisel and zone tillage) systems for processing tomatoes John O'Sullivan, (U. of Guelph), C. Swanton (U. of Guelph) and T. Vyn (U. of Guelph).

4. Development of methodology using image analysis technology to quantify soil pore distribution and assess changes in soil structure formation as impacted on by tillage practices. C. Fox (SCPFRC).

5. Effects of cropping and tillage practices on soil quality. R. Beyaert (SCPFRC) and P. Voroney (U. of Guelph).

6. Evaluation of zone tillage effects on limitations to successful no-till corn production R.P. Beyaert (SCPFRC), B. Ball Coelho (SCPFRC), R. Chapman (SCPFRC) and R. Roy (SCPFRC).

7. Quantifying the detrimental effects of improperly timed cultivation under no-till and conventional till practices. W.E. Curnoe, C. Topp, E. Gregorich, D. Lappan, N. McLaughlin.

Crop Rotation Research

1. Long-term effects of fertilization and rotation on soil quality and crop productivity. C.F. Drury (GPCRC), C.S. Tan (GPCRC), W.D. Reynolds (GPCRC), E.G. Gregorich (ECORC), P. Groenevelt (U. of Guelph) and H. Dadfar (U. of Guelph).

2. Overseeding cereal rye into standing corn to test effects on crop yields and movement of nitrates. B. Ball Coelho (SCPFRC) and R.C. Roy (SCPFRC).

3. Effect of rotational crops on suppression of populations of P. penetrans. B. Ball Coelho (SCPFRC), E. Riga and R.C. Roy (SCPFRC).

4. Corn root systems under long-term fertilization and crop rotation: a minirhizotron study. T.Q. Zhang, C.F. Drury, C.S. Tan, D. Reynolds (GPCRC).

Organic Composts & Paper Mill Biosolids Research

1. An evaluation of agronomic and environmental effects of application of composted source separated solid waste to agricultural land. C.F. Drury (GPCRC), W.D. Reynolds (GPCRC), C.S. Tan (GPCRC), R. Fleming (RCAT, U. of Guelph) and K. Denholm (GPCRC).

2. Effects of compost on processing crop production and soil and water quality under large scale no-till and conventional-till fields. C.S. Tan (GPCRC), C.F. Drury (GPCRC), W.D. Reynolds (GPCRC), J.D. Reynolds and T. Zhang.

3. Compost materials for turfgrass. Ken Carey and Greg Boland.

4. Optimizing the value of paper mill biosolids as a soil amendment on agricultural land in eastern Ontario. W.E. Curnoe

Irrigation & Water Table Management Systems

1. Effects of controlled drainage/subirrigation on processing tomato, corn and soybean yields and water quality at field scale. C.S. Tan (GPCRC), C.F. Drury (GPCRC), J.D. Gaynor (GPCRC) and T.W. Welacky (GPCRC).

2. Processing tomato production: determination of the effect of irrigation and fertigation on yield and fruit solids on a field scale. A. Liptay (GPCRC), C.F. Drury (GPCRC), C.S. Tan (GPCRC), W.D. Reynolds, and T. Jewett (GPCRC)

3. Irrigation and water budgets for turfgrass. Bob Sheard and Gary Parkin (U. of Guelph). Measurements of agricultural impacts on water quality, and the development of management practices to protect water resources. R. Fleming (U. of Guelph)

Greenhouse Gas/Carbon Sequestration Research

1. The influence of carbon sources, water and oxygen effects on nitric oxide and nitrous oxide emissions from soils. C. F. Drury (GPCRC), D.J. McKenney (U. of Windsor), S.W. Wang (U. of Windsor).

1. Diffusion systems within and above tall vegetation G. Thurtell (U. of Guelph).

General Soil & Crop Management Research

1. Influence of management on soil processes and soil void networks. R. Protz (U. of Guelph)

2. Optimizing soil and crop management practices for soils in E. Ontario. B. Curnoe (U. of Guelph).

3. A farming systems approach to assessing the sustainability and health of food production systems in Ontario. C. Swanton (U. of Guelph).

4. Evaluation of environmental impact of continuous vegetable production in organic and conventional farming systems. J. Tolman (SCPFRC), C. Fox (SCPFRC) and E. Topp (SCPFRC).

5. Development and measurement of soil parameters that indicate and/or quantify soil physical quality for high output and environmentally sustainable field crop production. W.D. Reynolds (GPCRC), C.F. Drury (GPCRC), and C.S. Tan (GPCRC).

6. The effects of surface applied versus no-till incorporated lime. D. Young (U. of Guelph) and J. Gaynor (GPCRC).

5-5. BEST MANAGEMENT PRACTICES ISSUE CHAMPION REPORT

Doug Aspinall, OMAFRA, Guelph

Site-Specific Crop Management

BACKGROUND:

Significant within field variability of soil properties, plant growth and crop yield has been well documented. Application of an agricultural input, such as fertilizer or pesticide, at a constant rate based on the average recommended value for the field would result in the over- and under- application of that input at various locations within the field. It is the goal of site-specific crop management (SSCM) to identify different management zones within a field so as to allow crop inputs and management levels to be varied to meet the requirements of the crop at individual locations within the field. Variable application of inputs could potentially increase the profitability of the farmer as well as reduce the risk of environmental contamination.

The recent technical developments in commercially available Global Positioning Units (GPS), yield monitors and variable rate applicators have greatly improved the ability of a farmer to carry out variable rate applications. The successful (equal or greater profitability of the farm and/or less of an negative impact on the environment) implementation of a SSCM plan, however, requires both the ability and knowledge of how to vary the input. It is the development, in a cost-effective manner, of the expert map for the field which depicts how the level of input changes spatially within the field that remains the biggest hurdle in the implementation of successful SSCM systems.

It has often been said that the practical agricultural aspects of this newer technology (such as various forms of remote sensing (e.g. satellite imagery, aerial photography), grid soil sampling, and soil conductivity mapping to name but a few) has landed on the doorstep of the farmer, agri-business, and the researcher at the same time. As a result, the farmer is being offered a myriad of services with very limited knowledge as to the usefulness of the information being collected or how such information should be used in developing a SSCM plan.

CURRENT STATUS:

The effort towards SSCM has increased during the past 4 years. Initial research efforts have focused primarily on the issues surrounding variable application of fertilizer nitrogen (N) in corn production systems. Various methods of identifying management units within the field based on crop response to fertilizers (delta yield) and soil N test is ongoing. These studies include an examination of the spatial and temporal yield and delta yield patterns in the field and how they relate to various soil properties, landscape position, land form shape and drainage. These studies have shown that fertilizer N requirements are not directly related to crop yields, and that a greater understanding of yield controlling parameters is needed to implement a successful SSCM plan. This work was one of the firsts in Ontario to use the high-resolution GPS as a means of developing topographic maps of fields, a practice, which is now offered by several commercial companies.

Other areas of investigation include examination of a spatially-variable sprayer for precision weed control, variable manure applications, phosphorus management strategies in variable soils, use of remotely sensing data in SSCM, EM38 mapping of soil properties as well as studies on variable populations and hybrids in corn production. Many of these projects are recent initiatives and are often run as complementary studies to work already in progress.

BARRIERS TO PROGRESS:

As indicated previously, many of these technologies and/or management options are commercially new and their use and/or usefulness in making management decisions largely untested. The limited resources available have been focused on areas deemed to be of highest priority with the greatest potential of having a significant impact on agriculture and the environment in general. Attempts to incorporate evaluations of some of the newer technologies, such as remote sensing data, into current studies have met with limited success due to the prohibitive costs associated with acquiring this information in a timely and suitable manner for research purposes.

SUB-ISSUES:

- Horticultural crops - overall a lack of research directly related to the use of this newer technology for this diverse range of crops.
- More work is needed on other areas of SSCM systems, particularly in the areas of the profitability and/or benefits of: variable phosphorus, potash from fertilizer and manure sources and lime application; variable populations; and hybrid selection.
- Data Management – producers with yield monitors are accumulating vast amounts of yield data, data storage and management strategies are issues. Software is becoming more sophisticated and expensive. Spatial data management skills training is required.
- Development of a complementary historical spatial data base over several years to aid the interpretation of yield maps. The database may include soil survey maps, topoography maps, bare soil and crop canopy aerial and satellite imagery, crop scouting reports, georeferenced soil samples
- Development of a protocol for on-farm experimentation using yield monitors and DIPS

EXPECTED PROGRESS IN NEXT FOUR YEARS:

Expected progress within the next four years will to a certain extended depend upon the level of activity that can be maintain in this area. The current level of activity should result in some definite guidelines for the variable application of N fertilizer in corn production. These studies, however, need to be conducted under as near to real farm conditions as possible and as such growing season conditions and length of crop rotations will greatly affect the time frame in which meaningful conclusions can be drawn from the data collected. The pending launch of satellites with a specific objective of supplying imagery for agricultural usage should greatly advance the understanding of how or whether such a technology can be used profitably by the farmer to make an informed management decision.

Ontario Research Projects Relevant to SSCM

Dr. M. Goss - Development of a comprehensive decision support system for manure management on swine and dairy farms

Dr. M. Goss - Evaluation of extraction techniques for estimation potentially available N from manure and soils to crops

Dr. G. Thurtell - Ammonia and nitrogen gas loss resulting from manure application

J. Oglivie - Programming a decision system package for manure management

B. Hawkins - Investigation and design of solid manure spreader beaters

H. Blais - Nitrogen losses from fall applications of liquid dairy manure

Dr. E. Beauchamp - Prediction of available N from soil organic matter and residual legume crop N

Dr. P. Groenevelt - Steady state baseline N leaching

Dr. R. Protz - Correlation of site-specific crop yield data to airborn and satellite imagery

Dr. I. P. O'Halloran
Site-specific crop management

Development of integrated weed management system: management of herbicide resistance and site-specific weed control

Mechanisms associated with stress tolerance and selection procedures for stress tolerance in corn

Integration of crop rotations, continuous versus rotational tillage systems, and nutrient management for sustainable corn and soybean production

Soil management research in Southwestern Ontario

Understanding crop yield dynamics in a temperate intercropped system

Technologies with the goals of reducing pesticide usage through enhanced coverage

Integrated weed management in field and horticultural crops

Corn Breeding and Genetics

Field validation of the soil temperature and water regime components of the SHAW model under Ontario geoclimatic conditions

Optimizing Methods of Applying Animal Wastes and Bio-Solids on the Land at Desired Rates

Quantifying the Detrimental Effects of Improperly Timed Cultivation Under No-till and Conventional Till Practices

Optimizing the Value of Paper Mill Biosolids as a Soil Amendment on Agricultural Land in Eastern Ontario

Prediction of Available N from Soil Organic Matter and Residual Legume Crop N

Base line Nitrate Leaching

Application of Ground Penetrating Radar for Design & Testing of Wastewater Trenches & Measuring Spatial Variability of Soil Moisture

Impact of Manure and Fertilizer Phosphorus Applications on Phosphorous Availability

Identifying Management Units for Site-Specific Nitrogen Management: Characterization of the Spatial and Temporal Stability of Yield Patterns

Greenhouse gas emissions, removal of air pollutants and nitrate leaching in management systems designed for carbon sequestration

Two and Three Dimensional Imagery of Soil Space

Conditioning of degraded and marginal soils with paper mill biosolids prior to planting grapes, peaches and agricultural crops.

A GIS and remote sensing system for agroecosystem monitoring and site specific crop management of agricultural Ontario.

Completing the First Phase of Farming Systems Research

Plant spectral analysis during early crop growth for site-specific nitrogen fertilizer management

Development of a single integrated computer program for the management of manure, biosolids and mineral nutrients

Evaluation of best management practices for increasing nitrogen use efficiency on farms

Modelling the Fate of Agricultural Pollutants

5-6. Biosolid / Waste Application and Treatment

Larry Schut. OMAFRA, Guelph

INFORMATION REQUIRED TO DEVELOP BIOSOLIDS PROTOCOLS

Two research projects are currently being undertaken in Ontario which are expected to provide information this will assist with the development of improved guidelines for the utilization of sewage and paper mill biosolids on agricultural land.

1) Application of Sewage Biosolids to Agricultural Land – Implications for Current and Future Productivity - Principle Investigator: Hale, OASIS #24280

   The findings should be very useful in assessing the adequacy of current guidelines for the utilization of sewage biosolids, and in developing new/improved guidelines for optimum use and environmental protection. Please see what Mike Goss reports for this study. You may want to use his report).

2) Paper Mill Biosolids Benefit Study
   Principle Investigator: Voroney/Organic Resource Technologies Inc.
   This is an entirely industry funded study to determine the benefits that result from the utilization of high C:N ratio (high carbon and low nitrogen content) paper mill biosolids on agricultural land. The second objective of the study is to determine the 'best management practices' needed to optimize benefit and minimize adverse impact on crop production (mainly soil nitrogen depletion due to high C content of biosolids).

   Nitrogen immobilization-remineralization in paper mill biosolids treated soils is unknown. The research includes a laboratory incubation study that will assess N immobilization-remineralization in treated soils.

   The study also includes a research plot component. This component will study the impact of increasing rates of spring and fall applied paper mill biosolids, combined with different rates of nitrogen application. Plots are presently located on a loam soil and a sandy soil. Additional plots will be placed on a clay soil. The target completion date of the study is fall of 2001.

   This study is expected to provide critical information in regard to: 1) the optimum application rate of high C:N ratio paper mill biosolids; and 2) the required nitrogen management practices necessary to facilitate decomposition of the biosolids and at the same time not cause soil N depletion or N movement to groundwater.

   The Biosolids Utilization Committee is hopeful that the information gained from this study, when available, will be of assistance in the development of a 'Best Management Practices' type information publication for the use of paper mill biosolids on agricultural land in Ontario.

5.7 Agriculture and Agri-food Table on Climate Change

STATUS REPORT

Maria Alles-De Vos, Policy Analysis Branch, OMAFRA

- ❑ The Table has completed a draft of an *Options Paper* and expects to release a final of the *Paper* sometime in mid December

- ❑ The *Options Paper* puts forward a number of recommendations in two key areas:
  - measures for reducing greenhouse gas (GHG) emissions in the Agriculture and Agri-food sector that can be implemented immediately or in the near future, with little or no cost to the sector; and
  - research requirements: 1) to improve our understanding of GHG emissions resulting from agriculture and agri-food activities, and 2) to develop effective mitigation measures to reduce these GHG emissions

- ❑ The recommendations concerning the reduction of GHG emissions have been developed based on best available science, taking into consideration the diversity of Canadian agriculture, regional differences, the present economic situation facing Canadian farmers and whether or not the measure makes good business sense

- ❑ The *Options Paper* recommendations will be presented to the Federal-Provincial-Territorial Deputy Ministers of Agriculture at their meeting in Charlottetown later this week

- ❑ If the recommendations are received favourably by the Deputy Ministers, they will be presented to a meeting of Federal-Provincial-Territorial Ministers of Agriculture in December

- ❑ The *Options Paper* will become one of a number of *Options Papers* from various Sector Tables (e.g., Forestry, Transportation, Energy, etc.) and Issue Tables (e.g., modelling, adaptation, emissions trading mechanisms, etc.) that will be taken into account in the development of a national strategy

- ❑ The federal government had wanted to be in a position to make an informed decision on ratification of the Kyoto Protocol by the end of 2000. It is probable that this deadline will slip given the that many Tables have not yet submitted their *Options Papers*

- ❑ The federal government does not intend to undertake any consultation on the Options Paper, but rather on the National Strategy which is suppose to be released sometime in late winter or early spring of 2000.

- The provincial government fully intends to consult on the *Options Paper* as a precursor to the development of a provincial position on a National Strategy

Priorities for Research

Projects For 1999/2000

Projects	Total
GHG Emissions and Economic Model for Ontario (GEEMO)	275000
Ministry Management Practices and Their Effect On GHG Emissions In Ontario's Agricultural Sector	180000
GHG Emissions In Ontario's Agri-Food Sector	100000
Assessing The Feasibility of Sequestering Carbon In Ontario's Farmland	50000
Measuring The Effects Of The Kyoto Protocol On Rural Ontario	?????
Total	**800000**

APPENDIX VI

Report of Action Taken on 1998 Recommendations. Responses to 1998 Recommendations

INFRASTRUCTURE ISSUE

ARIO Response to Infrastructure Issues

Data Collection and Management

We recognize the importance of preserving the land resource information and for coordination of the data collection and management. We would encourage OMAFRA, AAFC and the University of Guelph along with OMNR and the agri-food industry to develop a partnership to manage and fund the provincial agricultural land resource database.

Development of an agricultural water management databank and improvement of the availability and quality of weather data fall within the service area and the recommendations dealing with these infrastructure issues have been forward to OMAFRA's Agriculture and Rural Division for comment.

Scale

The effect of scale is a key element of all research. Projects funded by OMAFRA through the research programs at the University of Guelph are expected to outline technology transfer milestones which will take research results from the plot or laboratory bench to the end user. Researchers, as part of their routine research activities should be seeking to verify that results at the plot scale are applicable to the real world situation.

In the Agri-Food System Resources and Environment Program presented to ARIO in April scaling has been identified as a major goal in each of the six resource areas. In addition, the potential exists for research to be conducted directly on scaling through use of the open issue.

We note the request for an academic chair to study the scaling and encourage the agri-food industry to discuss ways of developing the substantial financial support needed to implement such a chair.

ISSUE: DATA COLLECTION AND MANAGEMENT
Priority 1-B

Recommendation #I-a1:

A. ***To establish a coordinated provincial framework for research, collection, management, application and transfer of Ontario agricultural land resource information.***

Response:

OMAFRA

This recommendation is fully supported. An emphasis should be placed on the importance in the development of data standards for all projects and initiatives fully compliant with the Natural Resource and Values Information System (NRVIS) topographic data model of MNR. Using provincial standardized framework will ensure compatibility with other data sets within the province. There are a number of initiatives within the Land Cluster Ministries, through Land Information Ontario, that will help transfer a formalized data analysis process and data standards development model.

University of Guelph

Land Resource Science supports a province coordinated effort for agricultural land resource information and will structure research to add data and insights to the better understanding of the land (soil) resources within Ontario.

AAFC

GPCRC - No activity
SCPFRC-No activity
ECORC -

B. ***To form a three-way partnership between OMAFRA, AAFC and the Land Resource Sci., Univ. of Guelph, to accept joint responsibility for the integrity of agricultural land resource information for Ontario, and having a mandate to improve the quality of land resource information through a program of data collection, management and analysis, to a level sufficient for the preparation of official plans, designation of agricultural lands (e.g. prime lands; degraded lands; lands posing risk to water quality), and other basic land use planning activities***

Response:

OMAFRA

Through the Natural Resources and Environment (NRE) Project in Land Information Ontario (LIO), pilot project around the soils information will help in the transfer of data analysis techniques and methodologies adopted by the NRE Steering Committee. The development of standardized data collection techniques, and analysis for soils information should help pave the way for further analysis of other data sets.

The development of a more formal relationship between LIO and the partnership proposed in this recommendation would provide benefits for all the organizations involved. There should be an active movement towards the development of data and information transfer between these land and resource management organizations.

University of Guelph

The Department of Land Resource Science will continue to do research on the application of remote sensed data for Agroecosystem monitoring. Currently research is on: 1) assessing data from the airborne high resolution cameras, 2) Doppler radar data for monitoring site specific rainfall events and 3) development of a mobile field vehicle to rapidly collect ground based data to validate airborne and satellite data.

C. ***To give joint responsibility to OMAFRA, AAFC, the Land Resource Sci., Univ. of Guelph, and OMNR for the development, production and distribution of spatial agricultural land resource information products, which relate to other provincial resource themes and which are interactive within OMNR's digital geographic information system.***

Response:

OMAFRA

This is a focus within the NRE project. MNR, OMAFRA and AAFC are in the process of formulating a detail Soil Project Plan, which will provide benefits to all users of this information. Geographic registration to a common database is critical when sharing data across organizations. The Natural Resource and Values Information System topographic data to georeference should be used as a standardized format.

University of Guelph

The department of Land Resource Science at the University of Guelph is developing a digital data base within ARC INFO of all of "Agricultural Ontario". This data base will include the road network, political boundaries., landsat (25m) imagery, soils and land forms maps. One of the purposes is to build and electronic file of the size of each agricultural field in Ontario. (This data base will be upgraded with higher resolution (5m) imagery from OMNR.

OMNR is coordinating the development of the "Natural Resource and Values Information System" (NRVIS). Inclusion of existing soils data was initiated by the Soils Data Capture Project Meeting in June 1999. Custodial responsibility would likely be with OMAFRA/AAFC/LRS. This would provide the framework for agroecosystem research and monitoring.

Land Resource Science is also continuing to develop methods, 1) CATSCAN (3D) and 2) soil thin section analysis (2D) for characterizing pedofeatures within soil space. An integrated digital database and processing will be required to analyse data on soil resources between large and small spatial and temporal scales.

b) WATER

ISSUE: DATA COLLECTION AND MANAGEMENT

Recommendation #I-b1: ***Develop an agricultural water management data bank.***

Priority: **1-B**

Response:
AAFC

GPCRC - No work is presently being done in this area by GPCRC. Water quality and water quantity are issues identified by the Great Lakes 2000 program and the COA (Canada-Ontario Agreement) as important in any renewal of these programs. This priority will be brought to the attention of representatives in these programs / committees to consider in future program establishment and resource issues.

SCPFRC- No activity.

ECORC ECORC is presently involved in the Eastern Ontario Water Resource Management Study. The study is a partnership between MOE, OMAFRA, AAFC and the rural municipalities of Eastern Ontario. The goals of the study are to develop a GIS database and associated planning tools to allow the municipalities to effectively plan for the sustainable development of rural land and water resources. Led by ECORC, a comprehensive regional scale database is being assembled to address surface and groundwater concerns. ECORC's role is assembly of the database, development of a data management system, and leadership of the technical advisor's group. Over the next two years, research will be directed at the development of analytical tools for regional planning.

University of Guelph

The University supports the concept of a unified data bank for water management. Many databases exist that if combined into a single entity would provide considerable information about the size and quality of Ontario water resources. The existing information is located in many federal and provincial ministries, universities, and other private institutions, often in the files of individual researchers. Recently the Water Quality Working Group of the Ontario Farm Environment Coalition established a data base for water quality of farm wells, but this data is held under strict confidentiality agreements. The proposed data bank will need to integrate all such information, and maintain the confidentiality of individual landowners.

The University will encourage participation of its researchers in participation of provincial efforts to develop the data bank.

c) AIR

ISSUE: DATA COLLECTION AND MANAGEMENT

Recommendation #I-c1: ***Maintain and improve the quality and availability of weather data in Ontario.***

Priority: 1-C
Response
ARIO

This recommendation has been forwarded to OMAFRA's agriculture and rural division for comment

OMAFRA

The ministry is supportive of the recommendation and continues to look for ways to improve the quality and availability of weather data in Ontario. The process of integrating selected stations from the U of G./OMAFRA weather station network into the Environment Canada network continues.

As well, PC based weather and climate data-handling protocols that apply the quality assurance criteria used by Environment Canada are being developed. Use of the internet as a method of data distribution has increased with development of OMAFRA's Ontario Climate Web page. We support this recommendation.

University of Guelph

a) Integration of stations from U of G./ OMAFRA network into Environment Canada Network

Slow progress toward this goal is being made, Environment Canada has visited, surveyed, and reported on most of the U of G/OMAFRA weather station sites. They are currently considering which of these stations might fill important gaps in their network from the point of

view of both climate data and their weather forecast program. No decisions from them as of this date. Much of this activity is being driven by requests from the Data Subcommittee of the Ontario Climate Advisory Committee, who have met twice on these matters since the 1998 OSWARSC Report. Also as a result of urging from this Subcommittee, EC is updating its data base of weather stations in Ontario, including networks operated by other government or private groups, so that station locations and data availability will be catalogued in one source document.

At present, the stations are being maintained at those sites where users are taking local initiative because they value the data. Gillespie met with Directors of the OMAFRA Environment, Plants and Animals Programs and requested input on which stations were essential (or at least important) to the activities in these Programs. Directors requested time to assess the situation with their research teams.

It appears that Environment Canada do not have resources to take over more than a few, if any, U of G/OMAFRA stations. However, they may be able to participate in a co-operative effort at selected stations, as described below.

b) Data handling Protocol

At this time EC may soon offer to enter into an agreement at selected stations where:

- standards for the instruments and their frequency of calibration are set out.
- arrangements for calibration of instruments through EC may be made.
- routine on-site maintenance will be required from a designated U of G/OMAFRA person; EC would provide training and a manual.
- in return for access to the data, EC would pass it through its quality assurance program and make the quality assured data available free of charge to the cooperating station.

Some discussion has occurred regarding the development of a quality assurance. tool that could be applied to their own data by local stations. These would be stations that do not participate with EC in the above scheme, but would like to maintain EC standards in quality assurance of data. This was proposed as a possible project in a senior engineering course at Guelph, but no student takers were found in the Winter '99 class.

c) Organization and presentation of a second data workshop

This is still an intended event, to be organized by the Ontario Climate Advisory Committee. However, items (a) and (b) have captured the action so far in 1999, and no firm plans for the second data workshop have been laid to date.

AAFC

GPCRC - The centre supports in principle the plan for a 2nd data workshop by the Ontario Climate Advisory Committee. Participation by AAFC is expected and support through registration costs will be provided by participating registrants.

SCPFRC -No activity

ECORC -

ISSUE: SCALING OF DATA; EVALUATION OF BEST MANAGEMENT PRACTICES

Recommendation II-1: ***To develop methodology to evaluate the effect of scale (mapping and spatial) on the quantification and management of soil and water resources.***

Priority: 1-A

Response:
OMAFRA

The ministry supports this recommendation.

University of Guelph

See ARIO response regarding scaling.

AAFC

GPCRC - At present there is no activity in this area. Centre researchers however have been participating in recent workshops by Environment Canada to identify needs for water quantity and water quality research under the Great Lakes 2000 program. Scaling work in water resource management has been given a high priority in this needs assessment. Future work will depend upon funding possibilities and support from other Federal departments and Provincial ministries. A proposal for resource support for this area has been distributed to funding agencies and potential cooperators.

SCPFRC - No activity

ECORC -

Research Issues

ARIO and University of Guelph response to OSWARSC research recommendations

In April, the University of Guelph presented the new Agri-Food System Resources and Environment program to ARIO. This research program will cover from 1999-2003 and combines the resources and mandates of the former Agri-Food Systems and Environment and Natural Resources research program. The new program will allow for research into the biophysical, economic and social implications of resource management issues confronting the agri-food sector in Ontario. Research will focus on the management of biophysical and socio-economic resources to ensure a competitive agri-food sector while enhancing and preserving the environment.

The Agri-Food System Resources and Environment program has been developed and refined over the past two years through a series of consultations which included OASCC committees, OMAFRA, AAFC and faculty at the University of Guelph. Drafts have been presented at OSWARSC meetings.

The program utilizes an issues based structure similar to that of the Environment and Natural Resources program which it replaces. It has been structured around 6 objectives corresponding to a biophysical or socio-economic resource and goals which outline a long term requirement for research (greater than 4 years). The objectives and goals will be re-evaluated every 4 years as part of the program review.

In order to address these objectives and goals a set of research issues have identified which will contribute to the long term requirements. The issues listed are in response to the identified needs for urgent information put forward by the OASCC committees. Research conducted on these issues will be expected to contribute to the overall objectives and goals of the program. Each issue has short term (4 years) desired outcomes listed.

The program proposal as presented to ARIO addresses all of the research recommendations brought forward by OSWARC. Project selection for the new program is currently underway. Once the projects have been finalized a document summarizing deliverables for each issue will be distributed.

A copy of the program proposal has been attached for your information. Details of the program can be obtained from the program director, Dr. Michael Goss. The program proposal is also available from the University's website at:

http://www.uoguelph.ca/research/omafra/documents/afsre.pdf

ISSUE: MANURE MANAGEMENT; NUTRIENT USE EFFICIENCY

Recommendation 1-1: ***Development of better manure and biosolid application methods to improve nutrient efficiency and reduce the impacts on environmental quality***

Priority: 1-B

Response:

OMAFRA

The ministry is supportive of this recommendation. Ministry staff continue to be quite active in this area. A number of projects have or are being developed to support nutrient management planning; such as, the NMan computer program, the NMP Workbook, the BMP – NMP booklet, a factsheet on P index and the NMP standards. P concerns are being addressed through the development of a P index based on a North American model. Staff are pursuing the development of a link between OMAFRA's NMan and the University of Guelph's MCLONE computer programs. The ministry continues to evaluate and work with innovative management practices to address the environmental implications of current nutrient management practices.

OMAFRA agrees that greater recognition of the nutrient content of biosolids, and greater nutrient use/efficiency, are needed in order to optimize the benefits from their use on agricultural land and avoid environmental impacts. OMAFRA staff members on the inter-ministry Biosolids Utilization Committee (BUC) have and will continue to promote efforts by the BUC to revise currently guidelines for the use and management of biosolids in agriculture, and to develop new guidelines if necessary, which achieve optimum nutrient use efficiency.

OMAFRA staff members on BUC have also been instrumental in recent decisions by the BUC, to require farmers who use biosolids to have a nutrient management plan. The BUC now recommends, for most biosolids, that the farmer develop or have in place a nutrient management plan.

AAFC

GPCRC - Studies have been initiated at Harrow in cooperation with U. of Guelph on compost application to soils for enhanced field crop production and improved soil quality. Studies on lime stabilized sludge effects on soil biological, chemical and physical properties are being conducted in partnership with industry. Funds have been allocated to have a new PDF in compost/biosolid research (Fall 99).

SCPFRC - A ManureNet system has been established by Dr. Bruce Bowman.

ECORC -

Recommendation 1-2: ***Environmental/Economic Determination of Efficient Manure Nutrient Management Systems for Intensive Livestock Operations***

Priority: 1-B

Response:

OMAFRA

The ministry is supportive of this recommendation.

AAFC

GPCRC - No activity (outside mandate)
SCPFRC - No activity
ECORC -

ISSUE: MANURE MANAGEMENT; WATER MANAGEMENT

Recommendation 1-3: ***Identification of Sources of Surface Water Contaminants***

Priority: 1-B

Response:

OMAFRA

The ministry is very supportive of this recommendation. A current project at the University of Guelph entitled "Development of a surface water testing procedure to determine species of origin for *Escherichia coli* bacteria" is a start. The ministry is partly funding this project.

Ministry of Health

The Ministry of Health has no mandate to deal with farming practice. We are of the opinion that the OMAFRA is the appropriate ministry to address the issue, arrange for the necessary research and develop a protocol if necessary.

The issue of pollution from septic tanks is a shared responsibility of the Ministry of the Environment (MOE) and the Ministry of Municipal Affairs and Housing (MMAH). The MOE has responsibility for the design and installation of all septic systems that generate 10,000 or more litres of sewage per day. A lakeside resort would use such a system. The Ministry of Health has no mandate with respect to the design, installation, use and maintenance of any sewage disposal systems regardless of size. Therefore we recommend that the MOE and the MMAH be approached regarding research and the development of protocols.

Suggested contacts at the two ministries are:

Bill Gregson, Director, Approvals, Environmental Assessment and Approvals Branch, MOE

Ann Borooah, Director, Housing Development and Buildings Branch, MMAH

AAFC

GPCRC - Work at Harrow on the effect of fertilization and crop rotation on soil and water quality with U of G. includes instrumentation of a field site to determine baseline data on damage, surface runoff and leaching of nitrate to tile drains and groundwater. On-going controlled drainage and sub-irrigation study at Woodslee includes surface water quality monitoring.

SCPFRC - There are two developing research projects which may provide molecular technologies for discriminating enteric bacteria originating from humans and livestock. One is at the University of Guelph (Professor Gyles) funded by NSWCP, the other is at SCPFRC (Dr. Topp) funded in part by Ontario Pork.

ECORC –

MOE

We understand that a number of activities by the Ausable-Bayfield Conservation Authority and the University of Guelph address this issue specifically.

Medium priority. Complete desired protocols for the above.

This research issue should focus on improving practices and guidance (ie manure management) to mitigate/eliminate contaminants from farming activities such as livestock and manure management. Please not that identifying sources of surface water contamination is very site specific and will vary from farm to farm - septic tank to septic tank.

ISSUE: NUTRIENT USE EFFICIENCY

Recommendation 2-1: ***Improving fertility management of cereal crops, canola, horticultural crops and all crops grown on environmentally sensitive soils, for increased sustainable productivity.***

Priority: 1-B

Response

AAFC

GPCRC - Harrow recently filled a new indeterminate position in soil/plant interface area. Studies have been initiated in determining optimum fertilizer rates and placement in the Horticulture area and for oilseed crops i.e "Response of selected soybean

varieties to various potassium sources". In 1999, work continued on tomato fertigation research even though a request for additional industry support was turned down. Other studies include; Nitrogen fertilization management for fresh market sweet corn and technology for prediction of available N from soil organic matter and residual crop nitrogen.

SCPFRC - No activity
ECORC -

Recommendation 2-2: ***Prediction of nitrogen release from organic sources***

Priority:1-C

Response:

AAFC

GPCRC - Technology for prediction of available N from soil organic matter and residual crop nitrogen in being conducted in cooperation with U of G. and through support from OCPA. Effects of yard waste compost on field crop production and environmental impacts of yard waste compost (leaves, lawn grass, bush) on soil quality is being examined. Soil organic matter levels are being monitored in a study on use of various composts (household, livestock manure) supplied to fine-textured soils.

SCPFRC - No activity
ECORC -

ISSUE: WATER MANAGEMENT (Wetlands and Riparian Zone Management)

Recommendation 3-1: ***Determining the Optimal Type, Width and Management of Riparian Buffer Strips to Reduce Sediment, Nutrient and Pesticide Loss into Watercourses***

Priority: 1-B

Response:

AAFC

GPCRC - No activity
SCPFRC- No activity.
ECORC - No activity

Recommendation 3-2: ***To quantify water quality functions for Ontario wetlands.***

Priority: 1-B

Response:
AAFC

GPCRC - No activity
SCPFRC - No activity.
ECORC - No activity

MOE

This is a very important component of integrated watershed management activities and environmental partnership projects. Recently, the development of a manual for riparian zone identification, protection and design has been proposed. This recommendation would greatly augment the development of the proposed manual.

The proposal is very timely and highly recommended.

Quantifying the water quantity functions for Ontario wetlands as they contribute to downstream watercourses and groundwater supplies should be considered.

ISSUE: SOIL AND CROP MANAGEMENT (Site Specific)

Recommendation 4-1: ***Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.***

Priority: 1-B

Response:

AAFC

GPCRC - No activity
SCPFRC - No activity
ECORC -

Recommendation 4-2: ***Developing crop rotation systems to enhance soil quality and improve crop productivity***

Priority:1-B

Response:

AAFC

ECORC - Studies are underway to assess the effects of corn-soybean rotation, receiving different organic and fertilizer amendments, on soil physical and biochemical properties and crop yield.

Recommendation 4-3: ***Overcoming factors limiting crop production when growing no-till corn and horticultural crops***

Priority: 1-C

Response:

AAFC

GPCRC - A study on soil hydraulic and aeration properties of soil under different tillage practices including no-till is being conducted in a corn-soybean-winter wheat rotation in cooperation with SCPFRC (London). Research on conservation tillage and weed management for processing tomato production is on-going. Work is underway to determine the impact of red clover on sweet corn residue combined with a rye cover crop on weed management strategies for conservation tillage processing tomatoes. Work is continuing on a long-term tillage study for corn cropped under conventional, no-till, and ridge till and under continuous blue grass cropping.

SCPFRC - No activity

ECORC -

ISSUE: EVALUATION OF BEST MANAGEMENT PRACTICES; NUTRIENT USE EFFICIENCY; WATER MANAGEMENT

Recommendation 5-1: ***To quantify the effectiveness of various Best Management Practices that are being recommended and implemented by the farm sector to reduce and/or control contamination of surface and ground water resources by agricultural fertilizers (organic and inorganic), pesticides, and sediments.***

Priority: 1-B

Response:

AAFC

GPCRC - No activity in this area on a water shed basis

SCPFRC - The OMAFRA nutrient management software program called "NMan" provides nutrient calculations for determining appropriate application rates of biosolids and livestock manures. The leaching of nutrients, bacteria and estrogenic hormones (endocrine disrupting chemicals) from field plots receiving Nman-recommended rates of swine manure is being evaluated on a plot scale.

ECORC - No activity

OMAFRA

The ministry is supportive of this recommendation. OMAFRA staff are currently involved with several projects of this nature; eg the PINUE Project in the Waterloo Region; the Strathmere Farm Project in Middlesex County (groundwater monitoring of nitrates), and the Total Phosphorous Management Project in the South Nations area of the province.

ISSUE: EVALUATION OF BEST MANAGEMENT PRACTICES; WATER MANAGEMENT

Recommendation 5-2: ***Development of techniques, practices and amendments that improve water management on fine-textured soils.***

Priority:1-B

Response

AAFC

GPCRC - Effects of controlled drainage and controlled drainage/subirrigation and N rate on corn and soybean production and water quality (herbicides and nitrates) is being evaluated in specific plot work and on two demonstration farms on coarse and fine soils

SCPFRC - No activity.

ECORC - No activity directed to water management. Tillage comparisons on fine-textured soils will lead to improved soil and water management.

ISSUE: BIOSOLID / WASTE APPLICATION AND TREATMENT

Recommendation 6-1: ***Conduct research to quantify short and long-term effects (positive and negative) of land application of biosolids, towards the development of application protocols based on their properties***

Priority: 1-A

Response:

OMAFRA

OMAFRA continues to assist the Water Environment Association of Ontario (WEAO), to develop and implement a multi-faceted research study of issues/concerns involving the utilization of sewage biosolids on agricultural land. The research study will be primarily industry funded, and involve first a thorough literature review of scientific information to identify any critical contaminants in sewage biosolids which may affect the quality of the receiving soils or plant, animal and human health. These include heavy metals, organic compounds and pathogens. The second part involves field-level research which will assess the fate and significance of any identified contaminants. OMAFRA will continue to assign staff resources to assist WEAO with the implementation of this research study.

OMAFRA staff have also assisted staff of the Ministry of the Environment (MOE), to define the scientific research needed to assess the benefits and detriments resulting from the utilization of paper mill biosolids on agricultural land. An industry funded research study of the benefits and detriments from application of paper mill biosolids on agricultural land, is now being carried out by a private consultant. OMAFRA staff presently sit on an inter-ministry steering committee for this study and will continue to participate as required.

Ministry of Health

The Biosolids Utilization Committee (BUC) is co-chaired by representatives of OMAFRA (Randy Jackiw) and MOE (Jim Janse). Members of the committee represent a variety of stakeholder interests including the academic community.

Proponents applying for approval to use biosolids material, other than municipal sewage biosolids, are required to submit appropriate supporting information to the Screening sub-committee of BUC. When data is not complete or methodology is not acceptable, this sub-committee informs proponents of this and identifies the areas that must be addressed. Proponents have the option to improve their submission or withdraw their request. In addition, the Screening Committee is drafting a document outlining the requirements of a scientific review to assist proponents in conducting studies that meet scientific rigour.

In order to maintain a current approach, BUC has conducted its own research into the effects of sewage biosolids application to agricultural land as it relates to heavy metals and dioxins.

The BUC Research sub-committee, lead by the OMAFRA co-chair, is mandated to ensure that research needs are addressed.

AAFC

GPCRC - Current studies in biosolid application with industry should contribute to our knowledge of appropriate rates and use of the products in agriculture. Harrow has initiated several new projects in partnership with industry whereby plot and field studies are being conducted to 1) develop best management practices for soil incorporation of municipal biosolids 2) to determine the impacts of biosolid application on soil and environmental quality. Other measurements include soil water storage, crop yield, soil strength, soil fertility, heavy metal concentrations, soil microorganisms, soil micromorphology, soil macrofauna, crop pests and diseases.

SCPFRC - No activity

ECORC -

MOE

Currently, the MOE is working with OMAFRA, BUC, Water Environment Association of Ontario (WEAO) and nine municipalities to initiate a study that will address the above recommendation.

The study will conduct a literature review and consult with regulators, experts and non-government groups to identify issues/contaminants (metal, organics and pathogens) that require further research to determine their short and long term impacts on agricultural lands and products, the environment, and humans; and recommend long term research priorities and Terms of Reference for the top three priority projects. The Terms of Reference will include suggested research methodologies, duration and budget.

Terms of Reference for the study have been issued to Universities, Agriculture and Agri-Food Canada and consultants to submit proposals. The study will start in the Fall of 1999 and be completed by the spring of 2000.

ISSUE: BIOSOLID / WASTE APPLICATION AND TREATMENT; WATER MANAGEMENT; MANURE MANAGEMENT

Recommendation 6-2: ***To develop practical remedial techniques for managing environmental impacts of existing contamination, and evaluating their economic feasibility.***

Priority: 1-B

Response:

OMAFRA - none

AAFC

GPCRC - Several new studies have been initiated in use of industrial and urban residential biosolids in crop production. There is no activity on use of biological or chemical treatments for remediation of pollutants or polluted sites.

SCPFRC -

ECORC -

MOE

While MOE is not conducting/funding research projects in this area, we are aware of effective technologies that can be used to treat intensive livestock agricultural wastes when needed.

ISSUE: GREENHOUSE GAS EMISSIONS

Recommendation 7-1: ***Continue to support the measurement and modelling of trace gases, and continue the association of this work with research on management systems for nitrogen and organic wastes.***

Priority: 1-B

Response:

AAFC

GPCRC - Current research studies in long-term effects of fertilization and rotation on denitrification and soil carbon are continuing in cooperation with ECORC and University of Windsor

SCPFRC - No activity

ECORC -

ISSUE: **BIOSOLID / WASTE APPLICATION AND TREATMENT; WATER MANAGEMENT; MANURE MANAGEMENT**

Service Recommendation

To give the Inter-Ministry "Biosolids Utilization Committee" (BUC) responsibility for:

1. ***Developing and implementing a provincial protocols for conducting scientifically-defensible research on utilization and management of off-farm wastes / biosolids on agricultural land.***
2. ***Communicating the research needs for use and management of wastes/biosolids in agriculture to the scientific community in Ontario***

Priority: **1-A**
Response:
OMAFRA

OMAFRA staff who are members of the inter-ministry Biosolids Utilization Committee (BUC) will promote efforts by the BUC to:

1. Develop a guidelines document which outlines the requirements for conducting scientifically defensible research on utilization and management of off-farm generated wastes/biosolids on agricultural land; and
2. Implement a notification process to communicate research needs for use and management of wastes/biosolids in agriculture, to the scientific community in Ontario.

AAFC

Assignment for interministry responsibility for this service recommendation is primarily a provincial issue.

MOE

See response to recommendation 6-1

Appendix VII

Summary of Distribution of 1999 Recommendations

TABLE 1. SUMMARY OF DISTRIBUTION OF OSWARSC 1999 **INFRASTRUCTURE RECOMMENDATIONS** **Recommendations**	AAFC	ARIO	CARC	OMAFRA	U of G	Other
Issue: Data Collection ,Upgrade, Management and Delivery						
1. Soil 1. To establish a provincial institute composed of MNR, OMAFRA, AAFC and Land Resource Science Dept., University of Guelph, to be responsible for the integrity of soil resource information for Ontario, and having a mandate to improve the quality of the soil resource information database through a program of soil research and data collection, management, analysis and transfer, to a level sufficient for the preparation of official plans, designation of significant/sensitive lands (e.g. prime agricultural lands; prime wetlands; degraded lands; lands posing risk to water quality), and other basic land use planning activities.	X	X	X	X	X	3
2. Water - Develop an agricultural water quality data bank.	X	X		X	X	2
3. Air - Maintain and improve the quality and availability of weather data in Ontario.	X			X	X	1
ISSUE: Spatial Scaling						
1. To develop methodology to evaluate the effect of scale (mapping and spatial) on the quantification and management of soil and water resources.	X	X	X	X	X	

1 Environment Canada
2 Ontario Ministry of Environment
3 Ontario Ministry of Natural Resources

TABLE 2. SUMMARY OF DISTRIBUTION OF OSWARSC 1999 RESEARCH RECOMMENDATIONS *ISSUE / RECOMMENDATIONS*	*OASCC Linkages (see note)*	*AAFC*	*ARIO*	*CARC*	*OMAFRA*	*U of G*	*Other*
1. Manure Management							
1) Development of better manure and biosolid application methods to improve nutrient efficiency and reduce the impacts on environmental quality	**ARSC** **FCRSC** **ERSC**	X	X	X	X	X	
2) Determine the best methods to evaluate the effectiveness of manure treatment technologies, and to develop protocols for evaluating treatment technologies including on-site testing for odours.	**ARSC** **ERSC** **RCDRSC**	X	X	X	X	X	
3) Identification of Sources of Surface Water Contaminants	**ARSC**	X	X		X	X	31
4) To quantify the biological, physical and socio-economic effects of manure management, in part by developing an environmental index for N.	**ARSC** **ERSC** **RCDRSC**	X	X		X	X	1
2. Nutrient Use Efficiency							
1) Improving NPK fertility management of corn, cereal crops, canola, horticultural crops and tobacco for increased yield, quality and profitability, and reduced environmental impact.	FCRSC HCRSC	X	X		X	X	
2) Improving secondary and micronutrient fertilization of field and horticultural crops.	FCRSC HCRSC	X	X		X	X	
3) To develop nutrient recycling for greenhouse nursery operations.	FCRSC HCRSC	X	X		X	X	
3. Water Management							
1) Determining the Optimal Type, Width and Management of Riparian Buffer Strips to Reduce Sediment, Nutrient and Pesticide Loss into Watercourses.	ARSC FCRSC	X	X		X		21
2) To quantify water quality functions for Ontario wetlands.	ERSC	X	X		X		2

TABLE 2 (cont'd). SUMMARY OF DISTRIBUTION OF OSWARSC 1999 RESEARCH RECOMMENDATIONS *ISSUE / RECOMMENDATIONS*	OASCC Linkages (see note)	AAFC	ARIO	CARC	OMAFRA	UofG	Other
4. Soil and Crop Management							
1) Improving the management, productivity and profitability of field crop production by increasing our understanding of temporal and spatial variability of soil properties in agricultural fields.	*FCRSC* *HCRSC*	X	X		X	X	
2) Developing crop rotation systems to enhance soil quality and improve crop productivity	*FCRSC* *HCRSC*	X	X		X	X	
3) Overcoming factors limiting crop production when growing no-till corn and horticultural crops	*FCRSC* *HCRSC*	X	X		X	X	
4) To Develop and calibrate of multi-element extractants suitable for Ontario soils.	*FCRSC* *HCRSC*	X	X		X	X	
5) To assess the impact of soil fertility and fertilizer additions on the functional food qualities of crops	*FCRSC* *HCRSC* *FPRSC*	X	X		X	X	
5. Best Management Practices							
1) To quantify the effectiveness of various Best Management Practices that are being recommended and implemented by the farm sector to reduce and/or control contamination of surface and ground water resources by agricultural fertilizers (organic and inorganic), pesticides, and sediments.	*FCRSC* *HCRSC*	X	X		X		
2) Development of techniques, practices and amendments that improve water management on fine-textured soils.	*FCRSC* *HCRSC*	X	X		X		

TABLE 2 (cont'd). SUMMARY OF DISTRIBUTION OF OSWARSC 1999 RESEARCH RECOMMENDATIONS *ISSUE / RECOMMENDATIONS*	OASCC Linkages (see note)	AAFC	ARIO	CARC	OMAFRA	U of G	Other
6. Biosolid / Waste Application & Treatment							
1) To conduct research to quantify short and long-term effects (positive and negative) of land application of biosolids, towards the development of application protocols based on their properties	**FCRSC** **HCRSC** **ERSC** **RCDRSC**	X	X	X	X		1 3
2) To develop practical remedial techniques for managing environmental impacts of existing contamination, and evaluating their economic feasibility.	**ARSC** **ERSC** **Econ.RSC**	X	X		X		1
7. Greenhouse Gas Emissions							
1) To continue to support the measurement and modelling of greenhouse (trace) gases, and to continue the association of this work with research on management systems for nitrogen and organic wastes.	**FCRSC** **ARSC** **HRSC** **ERSC**	X	X	X	X	X	4
2) To quantify the emission of greenhouse gases from agricultural activities, particularly in relation to manure management.	**same as above**	X	X	X	X	X	4
3) To quantify the impact, benefits and detriments of climate change and how to adapt to climate change; To quantify the impact, benefits and detriments of the Kyoto Agreement and how to adapt its ramifications.	**same as above**	X	X	X	X	X	4

CARC = Canadian Agri-Food Research Council; U of G = University of Guelph

1 Ontario Ministry of the Environment
2 Ontario Ministry of Natural Resources
3. Ontario Ministry of Health
4. Environment Canada

EconRSC - Economics Research & Services Committee
ERSC - Engineering Research & Services Committee

Note: OASCC Linkages refers to other OASCC Committees which would share ownership of this recommendation with OSWARSC. See acronym list (Appendix IX) for committee names.

Appendix VIII

Coding System for Research and Service Priorities

The Ontario Soil, Water and Air Research and Services Committee uses a two-part code to identify and rank research and service priorities.
For example:

1-A = Priority = very important, a new topic, no known activity
2-C = Priority = Important, continue research/services at existing level

The first part of the code identifies the priority of the research or services:

1. Very Important;
2. Important;
3. Desirable

The second part of the code indicates the known level of current activity related to the research or service:

A. New topic, no known activity (or external activity not applicable to Ontario;
B. Expansion needed, some activity underway;
C. Continue at existing level;
D. Decrease or discontinue.

APPENDIX IX

GLOSSARY OF ACRONYMS

Agencies / Associations / Centres / Departments	
AAFC	Agriculture and Agri-Food Canada
ARIO	Agriculture Research Institute of Ontario
CARC	Canadian Agri-Food Research Council
EC	Environment Canada
ECORC	Eastern Cereal and Oilseed Research Centre, AAFC Ottawa
GPCRC	Greenhouse and Processing Crops Research Centre, AAFC Harrow
KCAT	Kemptville College, University of Guelph
LRS	Land Resource Science Dept., University of Guelph
MOH	[Ontario] Ministry of Health
NWRI	National Water Research Inst., Environment Canada
OCPA	Ontario Corn Producers Association
OCSRE	Ontario Centre for Soil Resource Evaluation
OIP	Ontario Institute of Pedology
OLRU	Ontario Land Resource Unit, Agriculture and Agri-Food Canada (closed 1998)
OMAFRA	Ontario Ministry of Agriculture, Food and rural Affairs
OME	Ontario Ministry of the Environment (see also OMEE)
OMEE	Ontario Ministry of the Environment and Energy (see also OME)
OMNR	Ontario Ministry of Natural Resources
OSCIA	Ontario Soil and Crop Improvement Association
PFRA	Prairie Farm Rehabilitation Administration
SCPFRC	Southern Crop Protection and Food Research Centre, AAFC London
U of G	University of Guelph
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency

Committees	
ARSC	Animal Research & Services Committee
BUC	Biosolids Utilization Committee
OASCC	Ontario Agricultural Services Coordinating Committee
OARSC	Ontario Agrometerology Research and Services Committee
OERSC	Ontario Economics Research and Services Committee
OFCRSC	Ontario Field Crop Research and Services Committee
OFPRSC	Ontario Food Processing Research and Services Committee
OSMRSC	Ontario Soil Management Research and Services Committee
OSWARSC	Ontario Soil, Water and Air Research and Services Committee
ORCDRSC	Ontario Rural Community Development Research & Services Committee
OWMRSC	Ontario Water Management Research and Services Committee

Programs	
CURB	Clean Up Rural Beaches [Program] - OMEE
GLWQP	Great Lakes Water Quality Research Program (Agriculture Canada)
HEMS	Hog Environmental Management Strategy (AAFC)
NSCP	National Soil Conservation Program (Agriculture Canada)
NSWCP	National Soil and Water Conservation Program
OREP	Ontario Research Enhancement Program
PINUE	Partnerships in Nitrogen Use Efficiency (Water Quality Working Group)
SWEEP	Soil Water Environment Enhancement Program

Terms	
BMP	Best Management Practice
DSS	Decision Support System
EDC	endocrine disrupting compound
EFP	Environmental Farm Plan
GHG	Greenhouse gas

GIS	Geographic Information System
GPS	Global Positioning Units
IROWC - N, -P	Indicator of Risk of Water Contamination - for N, - for P
McCLONE3 NMAN98	Computer Manure/Nutrient Management Programs
NMP	Nutrient Management Plan
NPS	non-point source
SSCM	Site-Specific Crop Management

APPENDIX X

Provisional Committee Meeting Dates - 2000

Committee	Location	Dates
OASCC	OMAFRA, Guelph	February 22 - 24
OSWARSC	OMAFRA, Guelph	November 23 - 24
OARSC	OMAFRA, Simcoe	November 8
OSMRSC	ECORC, AAFC, Ottawa	June 13 – 14
Field Crops	OMAFRA, Guelph	February 29
Horticultural Crops	Woodstock	March 9
Soil and Water Quality	OMAFRA, Guelph	February 8
Soil Test Lab	Guelph	December 8
Waste Utilization	Husky Farm Equipment, Alma, ON	March 9
Tobacco		
OWMRSC		Aug or Sept.